WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN KANSAS--FISCAL YEARS 1981 AND 1982

Compiled by J. F. Kenny and L. J. Combs

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WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN KANSAS--FISCAL YEARS 1981 AND 1982

By

J. F. Kenny and L. J. Combs

ABSTRACT

One of the primary missions of the U.S. Geological Survey in Kansas is to investigate the occurrence, quantity, quality, distribution, and movement of surface and ground water throughout the State. Primary activities include the systematic collection, analysis, and interpretation of hydrologic data, evaluation of water demands, and water-resources research. Hydrologic investigations are conducted through four basic types of projects: (1) data-collection programs, (2) local or areal investigations, (3) statewide or regional investigations, and (4) research projects. These projects are funded through cooperative agreements with State and local agencies, transfer of funds from other Federal agencies, and direct Federal funds.

Forty-two water-related projects were funded during fiscal years 1981 and 1982 in Kansas. This report describes for each of these water-resources investigations the problem that initiated the study, the objectives of the project, and the approach designed to achieve this objective. Information on data-collection stations in Kansas is presented in maps and tables. A list of the 48 reports approved for publication by the U.S. Geological Survey, its cooperators, or technical and scientific organizations during fiscal years 1981 and 1982 is provided.

INTRODUCTION

The Organic Act of March 3, 1879, established the U.S. Geological Survey as a separate Bureau of the Department of the Interior. The Survey's principal mission became (1) the classification and survey of public lands, (2) the examination of the geologic structure and the mineral resources of the national domain, and (3) the determination of the water resources of the United States. Seven years later, in 1886, the first water-resources investigation by the U.S. Geological Survey in Kansas was completed by A. C. Peale. A cooperative program with the Kansas State Board of Irrigation and Surveys instituted the first streamgaging stations in western Kansas during 1895. The gaging program was extended to eastern Kansas in 1899.

From these early beginnings, the U.S. Geological Survey has expanded its work in Kansas to meet the growing demand for scientific data by Federal, State, and local agencies for use in the management of one of the State's most precious resources—water. The Kansas District, with headquarters in Lawrence and a subdistrict office in Garden City (fig. 1), investigates the occurrence, quantity, quality, distribution, and movement of surface and ground waters. Its activities include the systematic collection, analysis, and interpretation of data; the investigation of water demand for public supply, industrial, domestic, and agricultural purposes; and the research and development of new techniques to improve the scientific basis of data collection and investigative principles.

Hydrologic-data collection and analyses and investigative studies are conducted at project offices in Lawrence and Garden City. Hydrologic data management, the district sediment laboratory, computer applications, and the scientific reports section are centered at the District office in Lawrence. The fiscal year for Federal government operations extends from October 1 of each year to September 30 of the following year. In publications and data management of the U.S. Geological Survey this time period is also known as a water year.

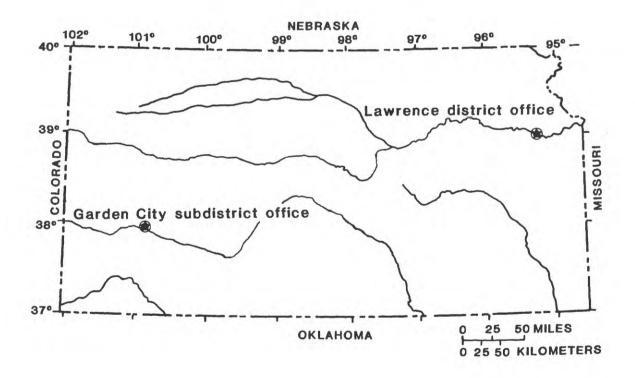


Figure 1.--Location of offices of the U.S. Geological Survey in Kansas.

PROGRAM FUNDING AND COOPERATION

Moneys for program operation of the U.S. Geological Survey in Kansas come from joint-funding agreements with State and local agencies, transfer of funds from other Federal agencies, and direct Federal allotments to the U.S. Geological Survey. Distribution of funding for program operation in FY81-82 is illustrated in figure 2. Those agencies cooperating with the U.S. Geological Survey in Kansas during the 1981 and 1982 fiscal years were:

State and local agencies

Kansas Geological Survey
Kansas Water Office
Kansas State Board of Agriculture, Division of Water Resources
Kansas Department of Health and Environment
City of Hays
City of Wichita
Western Kansas Groundwater Management District No. 1
Southwest Kansas Groundwater Management District No. 3
Kansas-Oklahoma Arkansas River Commission
Arkansas River Compact Administration
Harvey County

Federal agencies

- U.S. Department of Army, Corps of Engineers
- U.S. Department of Interior, Fish and Wildlife Service
- U.S. Department of Interior, Office of Surface Mining Reclamation and Enforcement
- U.S. Department of Interior, Water and Power Resources Service

PUBLICATIONS

Water-resources data and the results of hydrologic investigations in Kansas are published or released either by the U.S. Geological Survey, by cooperating agencies, or by journals of technical and scientific organizations. Requests for such information and for publications resulting from past or present investigations of the U.S. Geological Survey in Kansas should be addressed to one of the following:

District Chief
U.S. Geological Survey
Water Resources Division
1950 Constant Avenue - Campus West
Lawrence, Kansas 66044-3897
Phone: 913-864-4321

Subdistrict Chief U.S. Geological Survey Water Resources Division 206 Fulton Terrace Garden City, Kansas 67846 Phone: 316-275-4123

U. S. GEOLOGICAL SURVEY SUMMARY OF KANSAS DISTRICT PROGRAM

(Federal Fiscal Years 1981 and 1982)

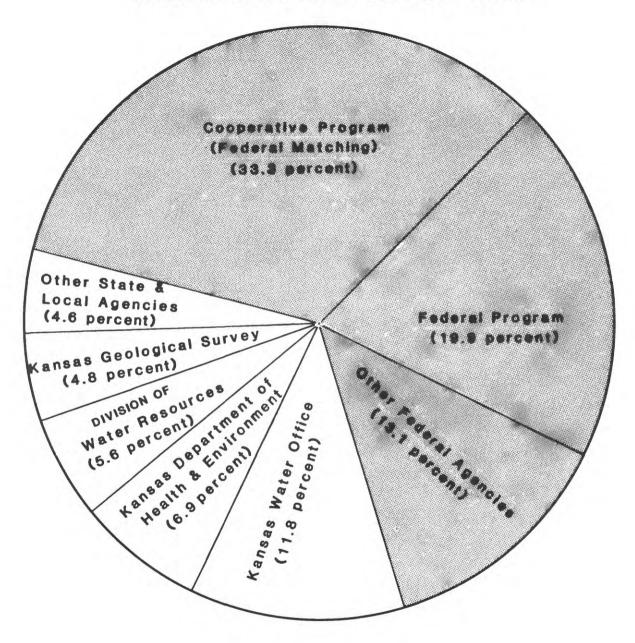


Figure 2.--Distribution of funding for the water-resources program of the U.S. Geological Survey in Kansas, fiscal years 1981 and 1982.

The U.S. Geological Survey also conducts an extensive mapping program in Kansas from its regional office in Rolla, Missouri. Standard topographic quadrangle maps published in the 7 1/2- and 15-minute series provide coverage for the entire State. To obtain an index to these topographic quadrangles or to purchase the maps, contact:

Kansas Geological Survey Publications Sales, 4th Floor 1930 Constant Avenue - Campus West Lawrence, Kansas 66045

For additional information on the U.S. Geological Survey's mapping program in Kansas, write to:

National Cartographic Information Center U.S. Geological Survey 507 National Center Reston, Virginia 22092

Studies in Kansas to investigate the frequency and extent of flooding have resulted in delineation of the 100-year flood boundary on selected topographic quadrangle maps (fig. 3). These maps are available from the Kansas District office in Lawrence.

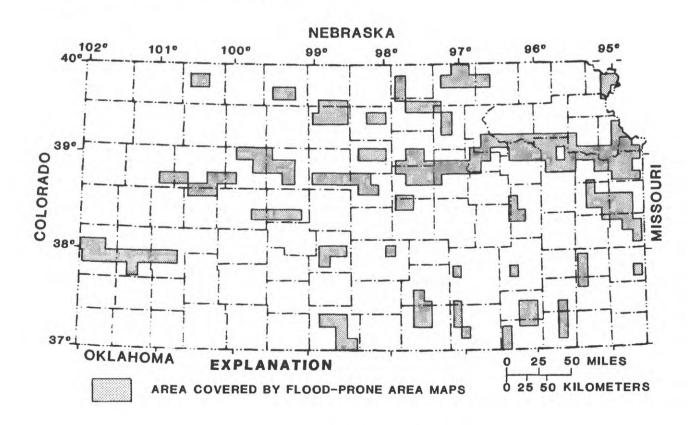


Figure 3.--Availability of flood-prone area maps.

DATA-COLLECTION PROGRAMS

Throughout its long history of service, the primary mission of the U.S. Geological Survey has remained the same-the comprehensive and systematic collection of hydrologic data and the timely release of such data for public use. To help provide this valuable service, a network of hydrologic-data stations is maintained throughout Kansas to obtain records of (1) stage, discharge, chemical quality, and sediment yield of streams; (2) stage, content, and chemical quality of lakes and reservoirs; (3) precipitation; and (4) water levels and chemical quality of ground water.

Hydrologic data collected in Kansas as part of the water-resources-data network are published annually in a comprehensive report entitled "Water-Resources Data for Kansas, Water Year 19--". Each water-data report carries an identification number consisting of the two-letter state abbreviation, the last two digits of the water year, and the volume number. For example, the report for the 1981 water year is identified as "U.S. Geological Survey Water-Data Report KS-81-1. Reports for each water year are released within the following year. Water-data reports are available from the U.S. Geological Survey office in Lawrence, Kansas, or from the National Technical Information Service, U.S. Department of Commerce, Springfield Virginia 22161.

Hydrologic data also are stored in both current and historical computer files in the U.S. Geological Survey's National Water-Data Storage and Retrieval System (WATSTORE). The data are available for water planning and management in machine-readable form, computer-printed tables or graphs, statistical analyses, and digital plots. Local assistance in the acquisition of computer services is available from the Kansas District office in Lawrence.

PROJECT TITLE: Surface-water data program

PROJECT NUMBER: KS-001

COOPERATING AGENCY: Multifunded PROJECT CHIEF: C. O. Geiger

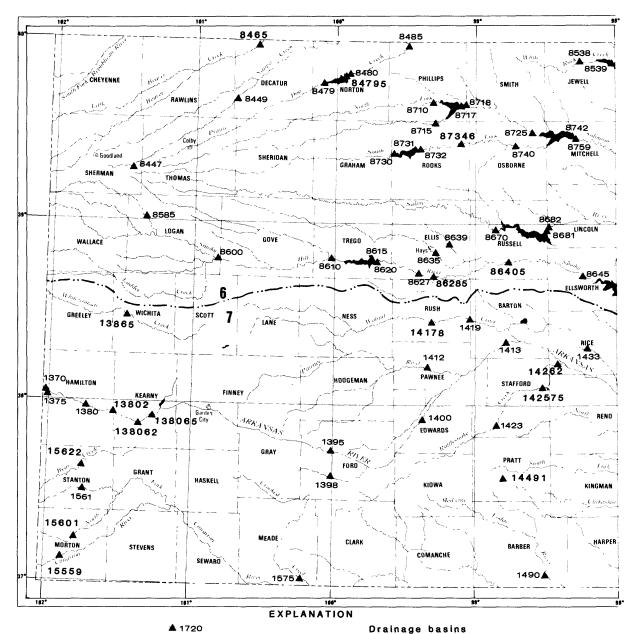
Problem -- Surface-water information is needed for purposes of surveillance, planning, design, hazard warning, operation, and management in such water-related fields as water supply, hydroelectric power, flood control, irrigation, floodplain management, and water-resources development. To provide this information, an appropriate and comprehensive data base is necessary.

Objectives -- Collect surface-water data sufficient to satisfy needs for current-purpose uses, such as (1) assessment of water resources, (2) operation of reservoirs or industries, (3) forecasting, (4) pollution controls and disposal of wastes, (5) discharge data to accompany water-quality measurements, (6) compact and legal requirements, and (7) research or special studies.

Collect data necessary for analytical studies to define, for any location, the statistical properties of, and trends in, the occurrence of water in streams, lakes, and reservoirs for use in planning and design.

Approach -- A network of gaging stations (figs. 4, 5, 6 and tables 1, 2, and 3 at the end of this report) is maintained to provide surface-water data for management and operation, for determination of long-term trends, and for research and special studies. Data are collected on stage and discharge of streams or canals, on stage, surface area, content of lakes and reservoirs, and on precipitation. The network of stations is revised periodically to ensure the collection of meaningful and worthwhile data.

Reports -- See numbers 45, 46, and 47 in "List of Reports...."



Complete-record stations and number

Note: numbers shown are abbreviated versions

of the complete numbers given in text

6 Missouri River basin
7 Arkansas River basin
Basin boundary

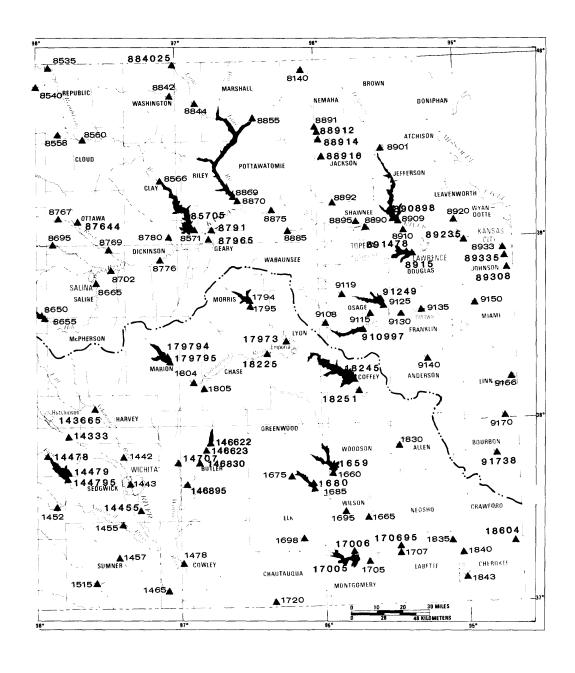
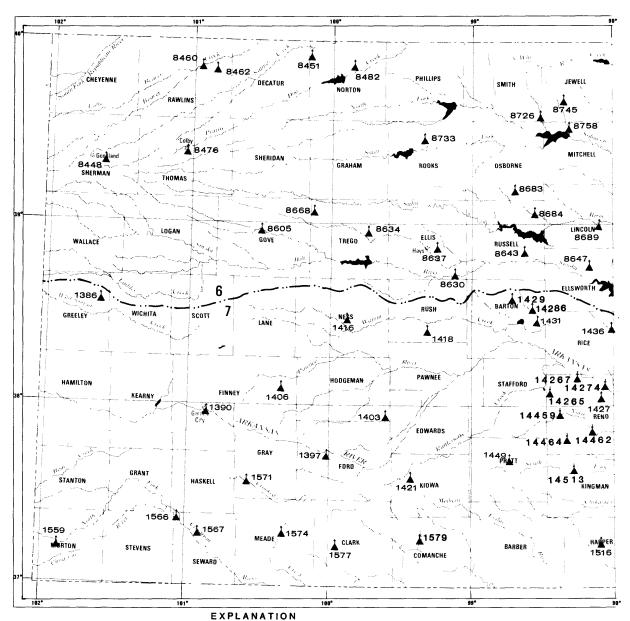


Figure 4.--Location of complete-record surface-water gaging stations, 1982 water year.



8137 Å Crest-stage station and number 1512 Å Low-flow station and number

Note: numbers shown are abbreviated versions of the complete numbers given in text

- Drainage basins Missouri River basin
- 7 Arkansas River basin

Basin boundary

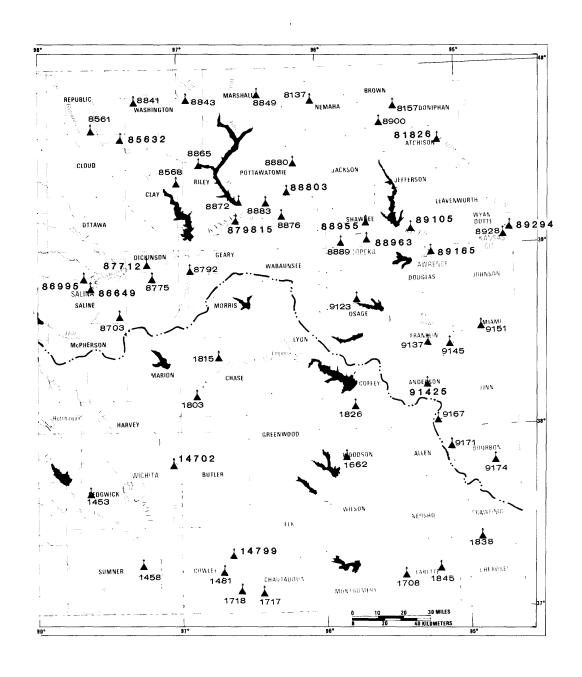


Figure 5.--Location of partial-record surface-water gaging stations, 1982 water year.

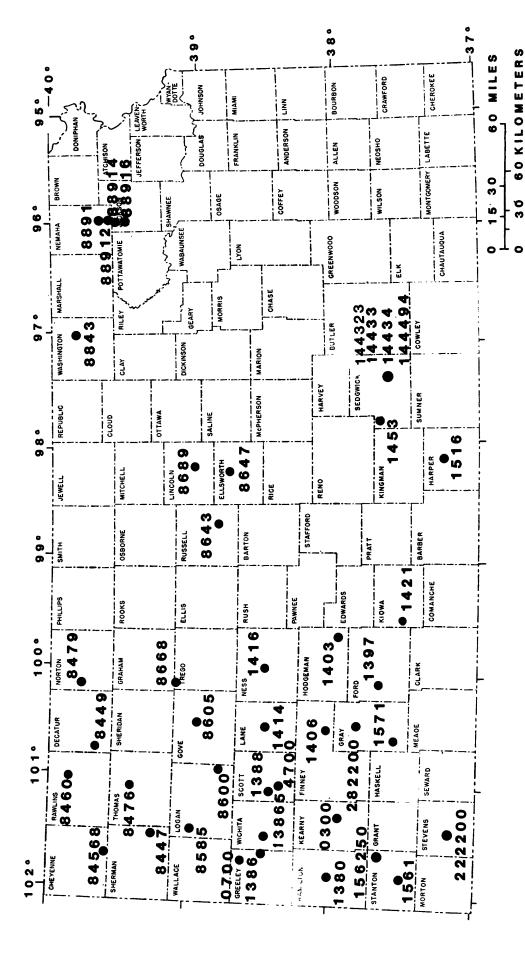


Figure 6.--Location of recording rainfall stations, 1982 water year.

PROJECT TITLE: Ground-water data program

PROJECT NUMBER: KS-002

COOPERATING AGENCY: Multifunded PROJECT CHIEF: C. O. Geiger

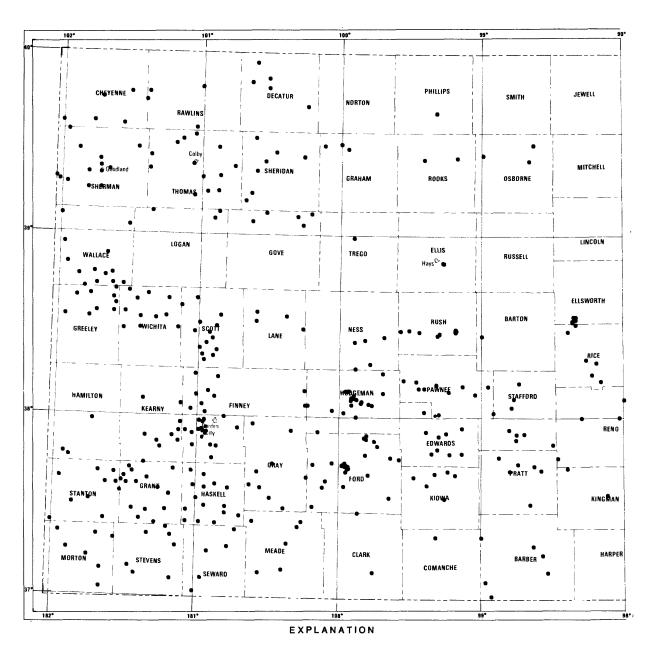
<u>Problem</u> -- Long-term water-level records are needed (1) to evaluate the effects of climatic variations on the recharge to and discharge from the ground-water systems in Kansas, (2) to provide a data base from which to measure the effects of development, (3) to assist in the prediction of future supplies, and (4) to provide data for management of the resource.

Objectives -- Collect water-level data sufficient to provide a minimum long-term data base so that the general response of the hydrologic system to natural climatic variations and induced stresses is known and so that potential problems can be defined early enough to allow proper planning and management.

Provide a data base against which the short-term records acquired in areal studies can be analyzed. This analysis must (1) provide an assessment of the ground-water resources, (2) allow predictions of future conditions, (3) detect and define pollution and supply problems, and (4) provide the data base necessary for management of the resource.

Approach -- A network of observation wells (fig. 7 and table 4 at the end of this report) is measured to provide a data base for monitoring the general response of ground-water systems to natural climatic variations and to stresses of pumpage. A long-term record of water-level measurements, in conjunction with a determination of the hydrological system, provides data for proper planning and management.

<u>Reports</u> -- See numbers 27, 28, 34, 35, 45, 46, and 47 in "List of Reports..."



 $\ _{e}$ 2 $\label{eq:continuous}$ Observation well $\ \ \, \text{Number indicates more than one well at this site}$

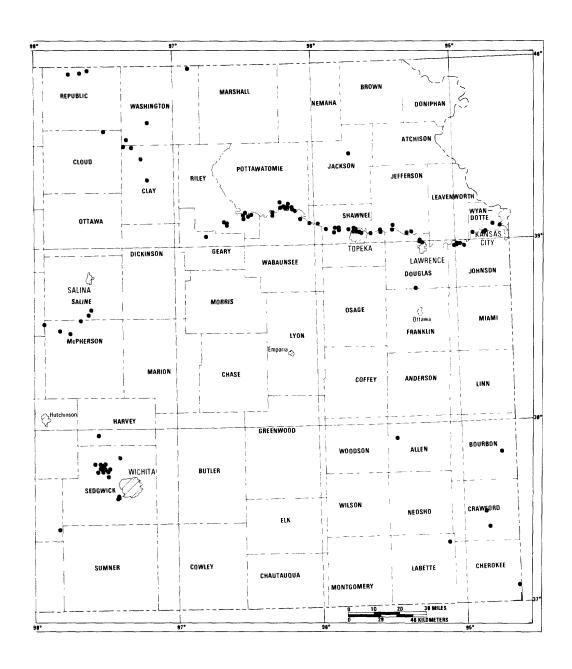


Figure 7.--Location of observation wells, 1982 water year.

PROJECT TITLE: Water-quality data program

PROJECT NUMBER: KS-003

COOPERATING AGENCY: Multifunded PROJECT CHIEF: C. O. Geiger

<u>Problem</u> -- Water-resources planning and water-quality assessment require a national data base of relatively standardized information. For intelligent planning and realistic assessment of the water resource, the chemical and physical quality of the rivers, streams, lakes, and reservoirs, as well as major ground-water aquifer systems, must be defined and monitored.

Objectives -- To provide a national bank of water-quality data for State, local, or Federal planning and action programs, and to provide data for the Federal management of interstate waters. Primary objectives of the network are to depict areal variability of streamflow and water-quality conditions nationwide on a year-by-year basis and to detect and assess long-term changes in streamflow and water quality.

Approach -- Surface-water-quality stations (fig. 8 and table 5 at the end of this report) are maintained in Kansas to monitor long-term and short-term trends related to changes in streamflow, reservoir operation, and local or regional pollution. In addition, a network for collection of surface-water-quality data, identified as the National Stream-Quality Accounting Network (NASQAN), is designed by the U.S. Geological Survey to meet many of the information demands of agencies or groups involved in national or regional water-quality planning and management. Water samples are collected at a few regular surface-water stations, as a Federal interagency activity, for monitoring and concentration and distribution of pesticides in streams where potential contamination could result from continued or future application of the commonly used insecticides and herbicides. As part of a nationwide sampling of major drainage basins, water also is collected at one station to be analyzed for radioisotopes.

Water-quality samples are collected from a network of wells to determine the chemical characteristics of ground water in the principal aquifers and to assess the suitability of the water for use in domestic and municipal supplies. The data also are used to establish an adequate data base for monitoring changes in water quality according to the provisions of the Safe Drinking Water Act, 1975. Other samples of ground water from various geologic formations at specific locations are analyzed for interpretive hydrologic investigations.

Reports -- See numbers 33, 45, 46, and 47 in "List of Reports...."

PROJECT TITLE: Sediment data program

PROJECT NUMBER: KS-004

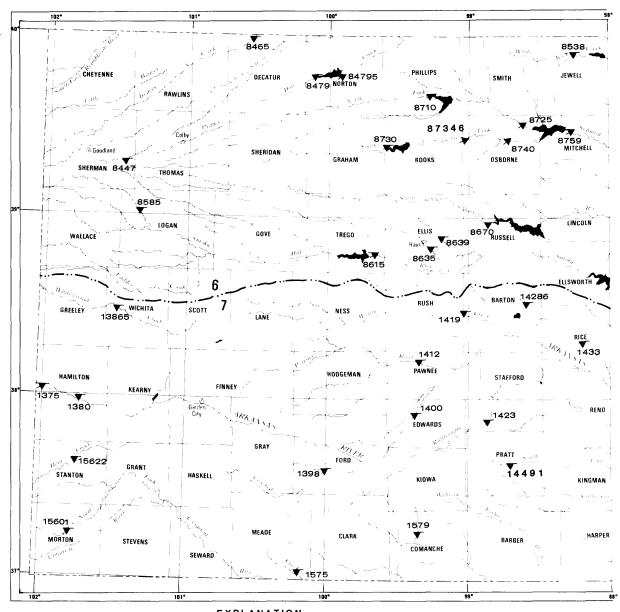
COOPERATING AGENCY: Multifunded PROJECT CHIEF: C. O. Geiger

<u>Problem</u> -- Sediment concentrations and discharges in rivers and streams must be defined and monitored in order to make a comprehensive water-quality assessment of the Nation's water resources.

Objectives -- To provide a national data base of standardized sediment information for use in State, local, and Federal planning and action programs, and to provide data for Federal management of interstate waters.

Approach -- A network of sediment stations (listed in table 5 at the end of this report) has been established to provide spatial and temporal averages and trends in concentration, discharge, and particle size of sediment being transported by rivers and streams. Water samples are collected on a routine basis at about 60 stations for analysis and determination or suspended-sediment discharge. In addition, periodic measurements are made of the particle-size distribution of suspended sediment and bed material.

Reports -- See numbers 45, 46, and 47 in "List of Reports...."



EXPLANATION

▼ Chemical **▼** Biological **▼** Sediment **▼** Temperature

Note: numbers shown are abbreviated versions of the complete numbers given in text

Drainage basin 6 Missouri River basin

Arkansas River basin

Basin boundary

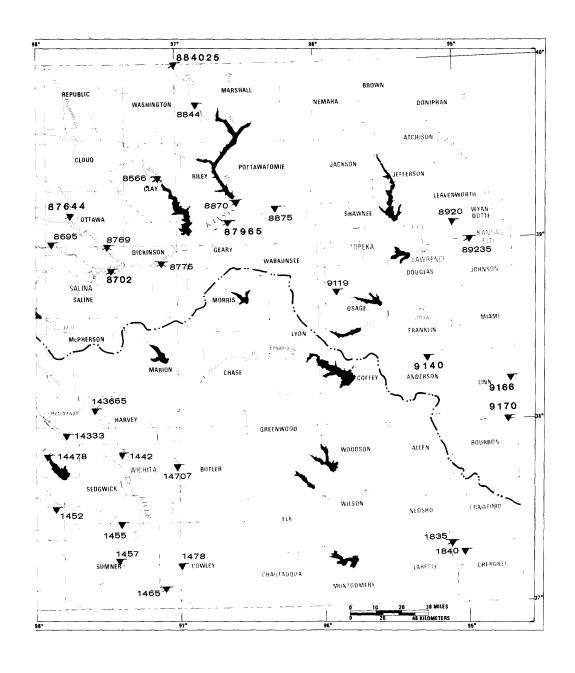


Figure 8.--Location of surface-water-quality gaging stations, 1982 water year.

PROJECT TITLE: Automated water-use data base in Kansas

PROJECT NUMBER: KS-007

COOPERATING AGENCY: Division of Water Resources, Kansas State

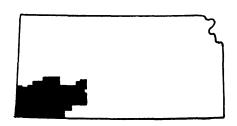
Board of Agriculture

PROJECT CHIEF: C. H. Baker, Jr.

Problem -- Use of Kansas waters and competition among types of uses are increasing each year. State water-rights agencies need detailed information about water use in order to effectively manage the resource. As part of the National Water-Use program in Kansas, plans have been made to create a State-operated and maintained water-use/water-rights data base. This long-term plan has been pushed into the immediate foreground by a growing concern within the State for automated handling of water-use/water-rights data. In order to facilitate the progress of the water-use program in Kansas and to ensure that the resulting State data base will fully meet the needs of the National Water-Use program, it is important for the U.S. Geological Survey to participate in the State data-base development.

Objective -- To design, implement, load, and evaluate an automated State water-use/water-rights data base. The data base will serve the dual functions of a management tool for administering water rights within the State and of acting as a repository for vital water-use data to meet National and State needs.

Approach -- Actual development of the data base will be done by the State Department of Administration, Division of Computer Services. Data capture, preparation, and input will be handled jointly by the Division of Water Resources, Kansas State Board of Agriculture, and the State Division of Computer Services. U.S. Geological Survey personnel will work closely with both State agencies to insure that all data elements needed for the National Water-Use program are provided in the data base and to provide for data exchange between the completed State data base and the National Water-Use Data System.



PROJECT TITLE: Hydrologic-data base for management decisions in Southwest

Kansas Groundwater

Management District No. 3

PROJECT NUMBER: KS-086

COOPERATING AGENCY: Southwest Kansas Groundwater Management District

No. 3

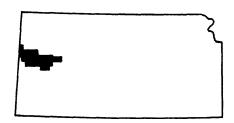
PROJECT CHIEF: J. M. Spinazola

Problem -- Management, planning, and administration of water rights depend on the availability of and ready access to hydrologic data. State and local water agencies that must make these decisions have requested establishment of a system to provide current information on (1) large-yield wells in southwest Kansas, (2) the amount and time distribution of ground-water withdrawals, (3) the amount and location of irrigated acreage, (4) the hydraulic characteristics of the Ogallala aquifer, (5) the configuration of the water table, (6) the annual changes in saturated thickness, and (7) the movement of ground water through the aquifer system. Most of these data are readily amenable to storage, retrieval, and analysis using digital computers.

Objectives -- To develop and maintain a comprehensive hydrologic-data base for the area within the Southwest Kansas Groundwater Management District and to provide timely storage, retrieval, and analyses of the data for use principally by the Management District and by the Division of Water Resources, Kansas State Board of Agriculture, in the management, planning, and administration of water rights.

Approach -- Establish and monitor a comprehensive observation-well network, complete and update an inventory of large-yield wells, perform several aquifer tests on selected wells, and assist the Management District in measuring and monitoring ground-water withdrawals for irrigation. Compile all data pertinent to the hydrology of the area in readily accessible computer files for various analyses essential to management and administrative decisions.

Reports -- See numbers 16 and 37 in "List of Reports...."



PROJECT TITLE: Hydrologic data base, Western Kansas Groundwater Manage-

ment District No. 1

PROJECT NUMBER: KS-117

COOPERATING AGENCY: Western Kansas Groundwater Management District No. 1

PROJECT CHIEF: J. M. Spinazola

Problem -- The original saturated thickness in Groundwater Management District No. 1 has been reduced 50 percent or more in five areas of the district covering about 225 square miles. Water is being pumped from the Ogallala aquifer 5 to 35 times faster than it is being recharged. Some irrigation wells have been abandoned, and the ground-water supply is no longer adequate for some domestic wells in areas where the aquifer has been dewatered. The Management District needs a continuing data-collection and analysis program to provide information on ground-water conditions for making management decisions.

Objectives -- (1) Maintain a current inventory of large-capacity wells to be updated at least every 3 years, (2) collect continuous water-level data in problem locations, (3) prepare annual ground-water depletion maps.

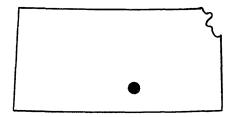
Approach -- Onsite-inventory data are used to update the Ground-Water Site Inventory (GWSI) data base, and current well tables and location of maps are provided to the district. Three continuous recorders monitor ground-water conditions in the district. Hydrologic maps produced using kriging techniques are supplied to the district annually. Previous maps have shown the water-table, errors-of-estimate, saturated thickness, and percentage change in saturated thickness of the Ogallala aquifer in west-central Kansas.

Reports -- See number 36 in "List of Reports...."

HYDROLOGIC INVESTIGATIONS

Hydrologic investigations provide water-resources information that is valuable for a wide variety of uses by Federal, State, and local agencies, by the general public, and by universities and the consulting community. These investigations may include regional, state, county, and site-specific studies, as well as applied research. Some of the anticipated uses of the results of these investigations include general resources information and definition of hydrologic systems; water supply (planning and development); protection and conservation of resources; pollution detection, control, abatement, and enforcement; bridge, culvert, and highway design; public safety (flood warning and flood-plain delineation); salinity control and abatement; hazardous waste disposal; land management: and fish and wildlife resources management. These investigations help to assess the State's water resources in terms of quality, quantity, and use of water, and to develop the knowledge and hydrologic understanding necessary to predict the consequences of alternative plans and policies for water development and use.

Areal or Local Investigations



PROJECT TITLE: Effects of urbanization on flood runoff in the Wichita area

PROJECT NUMBER: KS-013

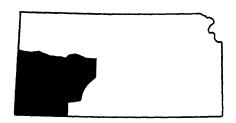
COOPERATING AGENCY: City of Wichita, Kansas

PROJECT CHIEF: C. A. Perry

<u>Problem</u> -- The effects of urbanization on flood-frequency discharges in Kansas have not been quantified. Sprawling urbanization in Wichita and vicinity has caused increased concern for the effect of urbanization on design discharges. Data on the magnitude and frequency of flood flows are needed in designing urban-drainage systems.

Objective -- Derive a method of estimating the relation of peak (flood) discharges to frequencies that is applicable to basins, with various degrees of urbanization, in the Wichita area.

Approach -- Collect rainfall-runoff data in basins where the land use and percentage of impervious surface can be determined. Define the shape of unit hydrographs and changes resulting from urbanization. Test and calibrate a digital rainfall-runoff model for predicting peak discharges from small urbanized basins.



PROJECT TITLE: Availability and chemical quality of ground water from

sandstone aguifers in southwest Kansas

PROJECT NUMBER: KS-079

COOPERATING AGENCY: Kansas Geological Survey

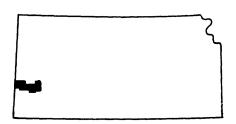
PROJECT CHIEF: Jack Kume

<u>Problem</u> -- A significant potential may exist for the development of ground-water supplies from sandstone units in Upper Permian, Upper Jurassic, and Lower Cretaceous rocks in southwest Kansas. Previous studies commonly considered the sandstone units as a single undifferentiated aquifer, which has lead to erroneous conclusions. Detailed studies are needed to define the geohydrology and the chemical quality of water in the sandstone-aquifer system.

Objectives -- Define the character of geologic formations that compose the sandstone-aquifer system; determine the geohydrologic relations between the individual aquifers; describe the chemical quality and suitability of water for most uses; and predict possible effects of ground-water development on the availability and chemical quality of water resulting from induced leakage between sandstone units.

Approach -- Compile data from previous studies and from existing wells and drill additional test wells to define the geologic and hydrologic characteristics of the sandstone-aquifer system. Obtain more detailed information on the areal extent, thickness, and degree of cementation of individual sandstone units and on the effects of hydraulic interconnection between units.

Reports -- See number 20 in "List of Reports...."



PROJECT TITLE: Geohydrology of Arkansas River valley in southwest Kansas

PROJECT NUMBER: KS-088

COOPERATING AGENCY: Division of Water Resources, Kansas State Board of

Agriculture

PROJECT CHIEF: R. J. Lindgren

<u>Problem</u> -- Flow of the Arkansas River between the Colorado-Kansas State line and the Kearny-Finney County line in Kansas has continued to decrease in recent years. Consequently, the availability of surface water for diversion at the headgates of irrigation ditches has been inadequate to meet demands. Withdrawals of ground water from wells in the valley alluvium, which is hydraulically connected to the stream, are thought to be depleting streamflow and adversely affecting senior water rights.

Objectives -- Define the relationship between ground water and surface water in the Arkansas River valley and determine the effects of ground-water withdrawals on streamflow. Construct and calibrate a digital model of the river-aquifer system that can be used by State and local management agencies to improve conjunctive use of ground and surface waters within the constraints of water-rights structure in Kansas.

Approach -- Determine the hydrologic boundaries of the stream-aquifer system, the hydraulic characteristics of the aquifer, the hydrologic stresses imposed on the system, and the effects of those stresses on ground-water storage and on streamflow. These data will be used in a digital model of the system to predict the results of various management alternatives designed to optimize conjunctive use of ground and surface waters.

Reports -- See number 1 in "List of Reports...."



PROJECT TITLE: Glacial deposits (Pleistocene) in northeast Kansas

PROJECT NUMBER: KS-091

COOPERATING AGENCY: Kansas Geological Survey

PROJECT CHIEF: J. E. Denne

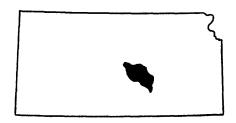
<u>Problem</u> -- As population and demand for water increase in northeast Kansas, ground-water supplies are gaining in significance. They are especially important during periods of low precipitation when surface-water supplies decline. Although the bedrock formations in the area generally contain little, if any, good-quality water, the glacial buried-valley aquifers may yield up to several hundred gallons per minute of freshwater to wells.

Because the buried-valley aquifers are variable in location, extent, and hydrologic characteristics, detailed study of them is necessary. Current aquifer usage and development potential for domestic, municipal, agricultural, and industrial needs also must be evaluated. These analyses will allow realistic water-resource planning for the area. Knowledge of aquifer locations also should allow protection of ground water from contamination.

The geophysical techniques (for example, seismic, resistivity, and thermal) developed and utilized in this program should prove useful for studies of other unconsolidated aquifers in Kansas.

Objectives -- The objectives of this study are to: (1) locate and de lineate the major Pleistocene aquifers of northeast Kansas, (2) determine ground-water levels in and saturated thicknesses of these aquifers, (3) analyze the Pleistocene stratigraphy and the character of the glacial deposits, (4) analyze the quality of waters contained in the Pleistocene aquifers, (5) determine current municipal, agricultural, and industrial usage of the aquifers, and (6) evaluate future potential of the aquifers for water supplies.

Approach -- Buried-valley aquifers will be located by evaluation of existing hydrogeologic information, interpretation of maps and remotesensing data, and onsite work (drilling and geophysical investigations). Ground-water levels will be measured in wells and test holes, and saturated thicknesses will be calculated. Grain size and clay mineralogy of sediments will be analyzed for stratigraphic correlation and aquifer evaluation. Chemical constituents of water from Pleistocene aquifers will be determined by sample analyses (performed by the Kansas Department of Health and Environment).



PROJECT TITLE: Hydrogeology of the "Equus beds" aquifer, central Kansas

PROJECT NUMBER: KS-092

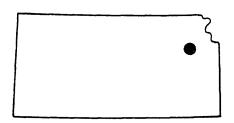
COOPERATING AGENCY: Kansas Geological Survey

PROJECT CHIEF: T. B. Reed

<u>Problem</u> -- Unconsolidated deposits of Pleistocene age, commonly known as the "<u>Equus</u> beds," are the major source of water for municipal, industrial, and irrigation use in central Kansas. Continued increasing withdrawals of water from this important aquifer will result in mining of water, reduced well yields, deterioration of water quality, and impairment of existing water rights.

Objective -- Determine the effects that increased ground-water with-drawals will have on (1) ground-water availability and (2) chemical quality of the ground water as they relate to the possible contamination of parts of the "Equus beds" as a result of induced movement of saline water now present in the aquifer and saline-water inflow from the underlying Wellington aquifer.

Approach -- Additional data will be collected with special emphasis on defining the chloride distribution in the aquifer and on modeling of the ground-water flow system. An appropriate model will be selected that will simulate the movement of saline water. Evaluation of the simulation will be made, and new model development may result.



PROJECT TITLE: Quality of water from urban runoff, Topeka

PROJECT NUMBER: KS-096

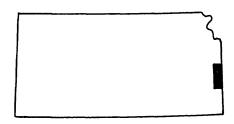
COOPERATING AGENCY: Kansas Department of Health and Environment

PROJECT CHIEFS: A. M. Diaz and L. M. Pope

<u>Problem</u> -- The Kansas Department of Health and Environment must obtain information to evaluate the impact of urbanization on the water resources of the State. Some Kansas counties are heavily urbanized, others currently are being urbanized, and still others are planned for urban development. One of the major urban developments in Kansas is in Shawnee County. A critical need exists for data relating to characteristics of urban runoff in the county, primarily with respect to the quality of water from runoff in the city of Topeka.

Objectives -- Establish a data base from selected study areas within the city of Topeka that will include streamflow, physiographic, climatic, and water-quality information. Evaluate the quality of water by defining the physical, chemical, and biological characteristics of runoff from selected urban areas under existing conditions and make projections of these characteristics of runoff that may occur with future urban development.

Approach -- Streamflow, physiographic, climatic, and water-quality data will be collected at selected sites, which will be equipped with stream-gaging and water-quality monitoring equipment. Data will be collected to determine the variation of water quality during storms and among seasons. Peak chemical concentrations and total chemical loads will be identified. Water-quality determinations will consist of chemical inorganics, trace metals, nutrients, organics, biological, bacteriological, and sediment.



PROJECT TITLE: Hydrologic consequences of strip mining the Mulberry coal

in Miami, Linn, and Bourbon Counties of eastern Kansas

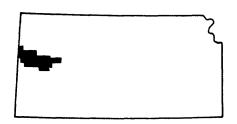
PROJECT NUMBER: KS-099 COOPERATING AGENCY: Federal PROJECT CHIEF: H. E. Bevans

<u>Problem</u> -- The thickest and most extensive remaining coal seam in Kansas is the Mulberry coal. Approximately 260 million short tons of Mulberry coal underlie a 300-square-mile area in Miami, Linn, and Bourbon Counties of eastern Kansas. The great thickness of overburden, up to 100 feet, that must be removed to mine this relatively thin, less than 4 feet, coal seam makes the stripping ratio (thickness of overburden to coal) one of the highest in the Nation. Coal-mining activities can present both immediate and long-term hydrologic consequences. In order to protect the hydrologic environment, State and Federal regulatory agencies and coal-mining companies require information regarding the premining hydrologic environment and the hydrologic consequences of coal mining.

Objectives -- Assemble and interpret the available hydrologic and related data necessary to describe the hydrologic environment. Determine and collect additional hydrologic data needed to describe the hydrologic environment and the consequences of coal mining. Describe the hydrologic consequences of coal mining in the study area.

Approach -- The investigation will be carried out in a systematic three-phase approach. Phase I will be to assemble and interpret available hydrologic and related data in order to describe the hydrologic environment and determine additional hydrologic data necessary to describe and determine the effects of coal mining on the hydrologic environment. Phase II will be an intensive data-collection period to acquire the additional hydrologic data. Phase III will involve interpretation of hydrologic data to determine the hydrologic consequences of coal mining in the study area.

Reports -- See number 18 in "List of Reports...."



PROJECT TITLE: Ground-water depletion maps, west-central Kansas

PROJECT NUMBER: KS-105

COOPERATING AGENCY: Western Kansas Groundwater Management District

No. 1

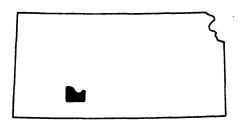
PROJECT CHIEF: L. E. Dunlap

<u>Problem</u> -- The ground water in west-central Kansas is being mined primarily for irrigation. The Western Kansas Groundwater Management District No. 1 has developed a management plan for this area based on the percentage depletion of the ground-water resources since 1950. The management district needs, on an annual basis, a map that will accurately represent the state of ground-water depletion and that will be relatively free from the effects of local anomalies.

Objectives -- (1) Investigate methods of transforming contour maps to digital form, (2) identify digitizing methods that will preserve the hydrogeologic interpretations of the various maps and provide consistent digital information on a square-mile basis, (3) select a reproducible methodology for preparing maps of saturated thickness and percentage change in saturated thickness, and (4) prepare maps of 3-year average saturated thickness and percentage change in saturated thickness since 1950 for Western Kansas Groundwater Management District No. 1.

Approach -- Simple polynomial interpolation, trend surface analysis, and other regionalization techniques, such as kriging, will be used to obtain estimates of bedrock elevation and water levels for each square mile of the Groundwater Management District using available point data. The utility of the different methods will be evaluated by preparing a saturated thickness map of the study area and by making comparisons with the map previously prepared by the point data and the bedrock/water-level contour intersection method.

Reports -- See numbers 7 and 8 in "List of Reports...."



PROJECT TITLE: Water resources of Ford County

PROJECT NUMBER: KS-106

COOPERATING AGENCY: Southwest Kansas Groundwater Management District

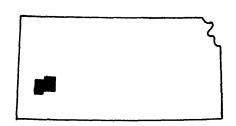
No. 3

PROJECT CHIEF: J. M. Spinazola

<u>Problem</u> -- The rate of depletion of the water resources in Ford County has accelerated in recent years. Increased ground-water pumpage and coincident drought conditions have caused declines in water levels. Water levels in the unconsolidated aquifer have declined 7 to 10 feet since 1940. Industrial and agricultural demand for water continues to be strong, and available data are not adequate for local water managers to allocate the diminishing water supply in an equitable and hydrologically sound fashion.

Objectives -- (1) Update the hydrologic data base for the county, including an estimate of water use from the unconsolidated aquifer, (2) document the areal aquifer response to pumping stresses, and (3) determine the availability of water, for irrigation or other uses, as defined by the guidelines of the Southwest Kansas Groundwater Management District No. 3.

Approach -- The hydrologic data base will be updated by an inventory of large-capacity wells in the county and by measurement of the discharge of about 8 percent of the wells. Total ground-water withdrawal will be estimated by an evapotranspiration model, which utilizes a soil-moisture accounting procedure. The aquifer's areal response to pumping will be shown by a water-table map constructed during the pumping season. Availability of water for large-capacity wells will be determined by using the water-table map and the 9-square-mile depletion model developed by the U.S. Geological Survey for a previous project in west-central Kansas.



PROJECT TITLE: Effects of ground-water withdrawals on water levels and

streamflow in the Arkansas River near Garden City

PROJECT NUMBER: KS-107

COOPERATING AGENCY: Division of Water Resources, Kansas State Board of

Agriculture

PROJECT CHIEF: R. J. Lindgren

Problem -- The flow of the Arkansas River at Garden City has diminished during the last decade such that the frequency of flow has decreased from about 90 to 10 percent. Concurrently, large-scale irrigation has developed in the sandhills south of the river from the Bear Creek fault in Kearny County to the vicinity of Garden City. Consequently, the yields of old irrigation wells near the river have decreased, and the rate of water-level declines has accelerated. Recent requests for appropriation of large quantities of ground water for industrial use in this area may adversely affect senior water rights.

Objectives -- Define the relationships among the Arkansas River, the valley alluvial aquifer, and the underlying unconsolidated aquifer of the Ogallala Formation; determine the changes in the relationship between the ground-water system and the Arkansas River; and construct, test, and apply a digital ground-water flow model to determine the effects of pumping ground water from the unconsolidated Ogallala aquifer south of the Arkansas River on flow of the river, on the yield of wells in the valley alluvial aquifer, and on water-level declines north of the river.

Approach -- Principal work items in this project will be to determine: (1) the hydrologic boundaries of the stream-aquifer system, (2) the hydraulic characteristics of the aquifers, (3) the hydrologic stresses that are being imposed on the system, and (4) the effects of the hydrologic stresses on the stream-aquifer system. These data will be used in a multilayer digital ground-water flow model of the system to evaluate the effects of various management alternatives on the availability of ground water and on flow of the Arkansas River.

Reports -- See number 21 in "List of Reports...."



PROJECT TITLE: Geohydrology and water quality of deep-aquifer systems,

Cretaceous and Jurassic ages, western Kansas

PROJECT NUMBER: KS-109

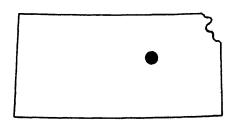
COOPERATING AGENCY: Kansas Department of Health and Environment

PROJECT CHIEF: Jack Kume

Problem -- The High Plains aquifer system has been stressed extensively in much of western Kansas. The underlying rocks of Cretaceous and Jurassic ages contain permeable units that have potential for use as alternative sources of water supply. The permeable zones within these rocks are used for disposal of brine that is produced with oil and gas from underlying rocks. A real hazard exists for contamination of the Cretaceous-Jurassic aquifer system if brine disposal continues without a sound hydrologic basis.

Objectives -- Define the geohydrology of the rocks of Cretaceous and Jurassic ages in detail at selected sites. Determine the vertical and horizontal variation in chemical quality of water in the permeable zones and determine the hydraulic-head differences between permeable zones and across confining beds. Determine the hydraulic characteristics of principal permeable zones and regionalize the results using available geophysical logs and other oil- and gas-exploration data.

Approach -- Use lithologic and geophysical logs of oil and gas test wells to determine test-drilling sites. A test-drilling program will provide detailed geohydrologic data needed to define the hydrology of the aquifers and the confining beds in the rocks of Cretaceous and Jurassic ages. Arrangements will be made to use selected unsuccessful oil and gas test holes before they are plugged or to re-enter plugged test holes. Special well-completion tests will be used, as applicable, to permit the independent measurements of hydraulic heads in permeable zones, the testing of hydraulic characteristics, and the obtaining of ground-water samples.



PROJECT TITLE: Geohydrology of Wellington Formation and Smoky Hill

Valley alluvium in Salina area, central Kansas

PROJECT NUMBER: KS-110

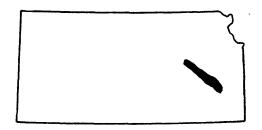
COOPERATING AGENCY: Kansas Water Office

PROJECT CHIEF: J. B. Gillespie

Problem -- Saline water is discharged from the alluvial aquifer into the Smoky Hill and Solomon Rivers east of Salina. The source of the saline water is brine from the underlying Wellington aquifer. The eastward movement of brine in the Wellington aquifer is believed to be confined to a limited cross section under the alluvium of the Smoky Hill Valley. A tight confining shale layer occurs between the two aquifers northeast of Salina. The most promising method for alleviation of saline-water contamination of the aquifer-stream system may be the construction of a line of relief wells in the area northeast of Salina. The brine discharged from the relief wells could possibly be injected into deep saline aquifers.

Objectives -- Define more accurately the area under which the brine is flowing eastward in the Wellington aquifer. Determine the volume of brine moving eastward and delineate any areas of saline-water contamination in the alluvial aquifer in the Salina area. Determine location of relief wells to intercept eastward-flowing brine and predict the effects of different pumping alternatives on brine flow by using a digital model.

Approach -- Test holes will be drilled on the north and south sides of the valley boundaries to determine if there is any brine following underneath the adjacent uplands. Also, additional wells will be installed in the Wellington aquifer underlying the valley alluvium. Aquifer tests will be conducted on these wells, and the brine will be injected into the deep Arbuckle aquifer. Short- and long-term aquifer tests will be conducted on both aquifers simultaneously. Observation wells will be augered in the alluvium. Water samples from both the Wellington and alluvial aquifers will be collected for chemical analysis. A quasi-three-dimensional digital model will be constructed to predict the effects of different pumping on brine flow.



PROJECT TITLE: Determination of stream discharge gains and losses under

drought conditions in the upper Neosho River valley

PROJECT NUMBER: KS-115

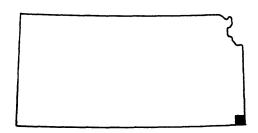
COOPERATING AGENCY: Kansas Water Office

PROJECT CHIEF: R. J. Hart

<u>Problem</u> -- The management of surface water and ground water, which are used for water supply and irrigation in the Neosho River, is becoming more critical. The use of water directly from the river for irrigation has increased in recent years. All the water supply available from John Redmond Reservoir, about 100 miles downstream from Council Grove, has been purchased; therefore, additional water supplies are only available from Council Grove Reservoir. In order to determine the required amount of water released at the reservoir to supply the target discharge at the point of use, natural streamflow gains and losses in the river must be quantified.

Objective -- The purpose of this study is to determine the magnitude of natural streamflow gains and losses during drought conditions in two reaches of the Neosho River. One reach is from the outlet of Council Grove Reservoir to Neosho Rapids, Kansas. The other reach is from the outlet of John Redmond Reservoir to the U.S. Geological Survey streamflow gage near Iola, Kansas.

Approach -- The approach to this study will entail a data-acquisition phase and a modeling phase. First, a data base will be developed from existing data and additional data that will be collected to adequately describe the stream-aquifer system. The modeling phase will entail selection, calibration, and verification of a stream-aquifer model. The modeling phase also will be devoted to using the calibrated model to determine streamflow losses under varying reservoir-release conditions during drought conditions.



PROJECT TITLE: Quality of water in lead-zinc mined areas of southeast

Kansas • KS_119

PROJECT NUMBER: KS-119

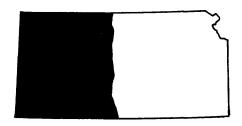
COOPERATING AGENCY: Kansas Department of Health and Environment

PROJECT CHIEF: T. B. Spruill

<u>Problem</u> -- Seepage from abandoned tailings piles and contaminated water from underground lead-zinc mines present a continuing source of chemical pollutants to ground and surface waters in a tri-state area that includes southwest Missouri, northeast Oklahoma, and southeast Cherokee County, Kansas. Determination of the characteristics and extent of pollution in the area is necessary in order to evaluate the severity of potential hazards to local water resources.

Objectives -- (1) Define water-quality characteristics of ground and surface waters of the lead-zinc mined areas, (2) determine extent and type of chemical pollution present, (3) describe the hydrology and geochemistry of the area.

Approach -- Collect water samples from mines, wells, and surface-water sites for chemical analysis, compile historical water-quality and hydrologic data, and evaluate data using appropriate statistical and geochemical analytical techniques. The extent to which the natural hydrologic system has been affected by abandoned lead-zinc mines will be examined.



PROJECT TITLE: Geohydrology and water quality of Cedar Hills Sandstone,

Permian age, Kansas

PROJECT NUMBER: KS-120

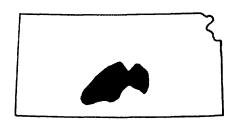
COOPERATING AGENCY: Kansas Department of Health and Environment

PROJECT CHIEF: H. E. McGovern

<u>Problem</u> -- The Cedar Hills Sandstone, a saltwater aquifer that has been used only for disposal of brine from oil and gas production, underlies the western one-half of Kansas. This aquifer is the probable source of large chloride concentrations that contaminate overlying freshwater aquifers in the alluvium of the Great Bend Prairie and in the Lower Cretaceous rocks of north-central Kansas. Saline water also discharges to major streams in these areas. Information on the mechanisms and effects of saltwater contamination are important to the management of ground-water and surface-water supplies.

Objectives -- Define the geohydrology of the Cedar Hills Sandstone, principally in areas where the included saltwater aquifer subcrops beneath major freshwater aquifers. Determine the potentiometric head and chemical quality of water in the Cedar Hills Sandstone. Determine the areas of hydraulic connection between the different aquifers, the direction of water movement, and the resulting changes in the chemical quality of water.

Approach -- Use lithologic and geophysical logs of oil and gas test wells to define the extent and character of the Cedar Hills Sandstone. Analyze data on potentiomeric head and chemical quality of water to determine hydrologic relationships between the Cedar Hills aquifer and overlying aquifers. Arrangements will be made to obtain data from disposal wells for determining hydrologic characteristics. Selected observation wells will be established for monitoring changes in hydraulic head and chemical quality.



PROJECT TITLE: Natural ground-water recharge dynamics in the Kansas Plains

PROJECT NUMBER: KS-122

COOPERATING AGENCY: Kansas Geological Survey

PROJECT CHIEFS: Marios Sophocleous and C. A. Perry

<u>Problem</u> -- Recent large-scale irrigation development in Kansas and the consequent declines in ground-water supplies focused attention on ground-water recharge rates. These rates are not sufficient to meet the current demands over a long period of time. The lack of detailed information about natural recharge aggravates the problems of planning for and managing the ground-water resources of Kansas.

Objectives -- (1) Investigate the mechanisms of natural ground-water recharge; (2) quantify the amount of recharge water and specify its time distribution for two areas in Kansas, one in the "Equus beds" and the other in the Big Bend region; (3) study and evaluate the latest technology with regard to instrumentation and techniques for studying ground-water recharge; and (4) coordinate onsite and laboratory measurements with mathematical modeling techniques in order to develop improved methods of estimating ground-water recharge.

Approach -- Instrument two experimental sites and provide integrated and automated measurements of the subsurface flow regime on a year-round basis. Supplement onsite data with laboratory determinations and use such data in appropriately modified numerical models to better understand and predict the recharge process.

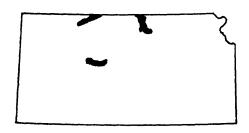
PROJECT TITLE: Atmospheric fallout and contribution to urban runoff

PROJECT NUMBER: KS-123 COOPERATING AGENCY: Federal PROJECT CHIEF: K. D. Medina

<u>Problem</u> -- Atmospheric-fallout data are needed to enhance the collection, analysis, and interpretation of stormwater data from urban watersheds.

Objectives -- Install automatic sampling devices for collection of wetfall-dryfall samples and perform chemical analysis of samples.

Approach -- The wetfall samples will be removed following each rainfall event, and the dryfall samples will be removed on a monthly schedule. Chemical analysis and interpretation will be included as part of the Topeka urban-runoff project (KS-096).



PROJECT TITLE: Effects of irrigation return flow on the chemical quality

of water in the Smoky Hill River, Prairie Dog Creek, and

Republican River, Kansas

PROJECT NUMBER: KS-125

COOPERATING AGENCY: Kansas Department of Health and Environment

PROJECT CHIEF: T. B. Spruill

<u>Problem</u> -- Although ground water now provides the principal source of irrigation water in central and western Kansas, surface-water sources may become more important in the future because of gradual depletion of ground-water reservoirs. Application of irrigation water in a semiarid region, such as western Kansas, may cause changes in the local hydrologic regime, as well as causing potentially deleterious changes in the soils and in ground- and surface-water quality, so that water draining from the irrigated basin may be rendered unfit for other uses. There is a need to document current conditions and possible long-term deleterious effects of irrigation to provide information useful for management decisions directed at minimizing these problems.

Objectives -- (1) Areally define post-irrigation season surfaceand ground-water quality characteristics within the irrigation districts and adjacent areas in the Prairie Dog Creek and Republican River valleys. (2) Statistically compare possible differences in surface- and groundwater quality of areas within each irrigation district that are minimally irrigated, irrigated with ground water, and irrigated with surface water. (3) Define possible seasonal changes in hydrologic conditions and ground- and surface-water quality of areas that are minimally irrigated, irrigated with ground water, and irrigated with surface water. (4) Determine possible long-term effects of ground- and surface-water quality in the Cedar Bluff and Almena Irrigation Districts.

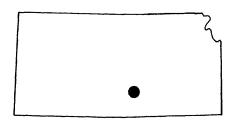
Approach -- Twenty to 40 irrigation, domestic, and public-supply wells will be selected in each of the three areas. Each of these areas will contain 6 to 15 wells in subareas that are irrigated with ground water, irrigated with surface water, and nonirrigated. Wells in the Almena and Cedar Bluffs Districts will be sampled during the fall 1981, and spring, summer, and fall 1982. The wells in the Bostwick District will be sampled every 6 weeks from April to November 1982.

Seepage surveys are to be performed at 20-30 sites along the Smoky Hill River and Prairie Dog Creek during fall 1981, and spring, summer, and fall 1982. Seepage surveys will be performed at 30-40 sites spring, summer, and fall 1982 along the Republican River.

Specific conductance, pH, temperature, and major chemical constituents, nutrients, selected trace elements, and organic compounds will be determined at each well and seepage-survey site.

Ground-water level data in each area will be obtained from U.S. Bureau of Reclamation water-level monitoring programs.

The evaluation phase of the study will involve statistical manipulation of the data using analytical programs available on local computer facilities and writing reports.



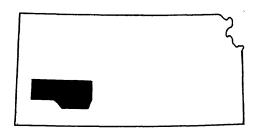
PROJECT TITLE: Regional flood-frequency relations in the Wichita area

PROJECT NUMBER: KS-126 COOPERATING AGENCY: Federal PROJECT CHIEF: R. J. Hart

<u>Problem</u> -- The U.S. Geological Survey is preparing a report on the calibration of a rainfall-runoff model, synthesis of a long-term annual flood series, and evaluation of urbanization effects of flood frequency for the Wichita area (see Project Number KS-013). Because of limited project funding, this report will be based on only three rainfall-runoff stations out of a possible 12, and regionalization will, therefore, not be possible. However, additional funding has provided the opportunity to expand the scope of the planned data analysis, and thus greatly enhance the usefulness and value of the project.

Objectives -- The objectives of the study are to: a) improve the evaluation of urbanization effects; b) develop a regional flood-frequency relation for urban watersheds in Wichita, and c) compare the regional relation to relations developed in a National urban-runoff study.

Approach -- From the nine other sites at which rainfall-runoff data are available, an additional two to four stations will be selected for the modeling process. Synthetic flood-frequency relations then will be developed for the synthetic annual-flood series for evaluation of urbanization effects. Regionalization of specific flood characteristics for these five to seven stations will be attempted using conventional multiple-regression techniques. The synthetically derived station flood characteristics and regionalized flood characteristics also will be compared with results from relations developed in the National urbanrunoff study.



PROJECT TITLE: Hydrology of the Lower Cretaceous sandstone aguifers of

southwest Kansas

PROJECT NUMBER: KS-127

COOPERATING AGENCY: Groundwater Management District No. 3

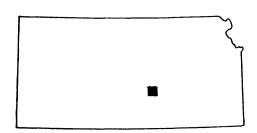
PROJECT CHIEF: K. R. Watts

<u>Problem</u> -- Sandstones of Early Cretaceous age form a major aquifer system in southwest Kansas. As the heavily developed High Plains aquifer becomes depleted, more water users will tap the resources of these deeper aquifers. The Southwest Kansas Groundwater Management District No. 3 is responsible for controlling development of ground-water resources in parts of southwest Kansas, and has established criteria for well spacing and yield appropriation of ground water. Detailed knowledge of the hydrology of the sandstone aquifers and possible hydraulic connections with the High Plains aquifer and underlying aquifers is needed so that the management district may refine their selection criteria.

Objective -- To define the hydrologic boundaries, aquifer characteristics and fluxes, potentiometric surfaces, water quality, and the water-supply potential of these aquifers and their connection with adjacent aquifers.

Approach -- (1) Lithologic and geophysical data will be used to refine the knowledge of the geologic and hydrologic boundaries of these aquifers;

- (2) aquifer characteristics, transmissivity, and storativity will be determined with available pump-test data and estimation techniques;
- (3) water-level information will be gathered from existing observation wells and a temporary observation-well network will be established;
- (4) water use from the aquifers will be estimated for major water users; metering will be required on all new wells, and water use will be reported;
- (5) an inventory of large-capacity wells tapping these aquifers will be used to update the Ground-Water Site Inventory (GWSI) files; and
- (6) a three-dimensional finite-element ground-water flow model consisting of up to four layers will be calibrated and used to assess management strategies.



PROJECT TITLE: Natural ground-water recharge in Harvey County, Kansas

PROJECT NUMBER: KS-128

COOPERATING AGENCY: Harvey County

PROJECT CHIEF: C. A. Perry

<u>Problem</u> -- The "<u>Equus</u> beds" aquifer supplies large quantities of water for cities including Wichita and Newton, as well as for irrigation, at a steadily increasing rate. The Harvey County Planning Office needs information on the natural recharge of this aquifer in areas of different unsaturated-zone lithologies in order to best direct development in this area.

<u>Objective</u> -- To determine natural ground-water recharge rates in areas of different soil types in Harvey County.

Approach -- Three satellite sites will be established in conjunction with the ongoing recharge project, KS-122. Sites will have an observation well, a neutron moisture-probe access tube, and a recording raingage. Data collected will be used in an unsaturated-flow simulation model to estimate the natural ground-water recharge.

Statewide or Regional Investigations



PROJECT TITLE: Flood hydrology and hydraulics for transportation appli-

cations.

PROJECT NUMBER: KS-010

COOPERATING AGENCY: Kansas Department of Transportation

PROJECT CHIEF: R. W. Clement

Problem --There is a continuing need for adequately defined flood-frequency characteristics for Kansas streams to assist in the efficient design of highway drainage structures, for flood-plain analysis, and to evaluate flood-risk factors. Long-term records of annual peak discharges are necessary to adequately define flood-frequency characteristics. Although streamflow records have been collected on Kansas streams since 1895, they are limited primarily to those streams that drain areas larger than 100 square miles. Very little long-term data are available for streams draining areas of less than 100 square miles.

Objectives -- Define the flood-frequency characteristics on gaged streams in Kansas using long-term data, both observed and synthesized, and develop techniques to extend those characteristics to ungaged locations.

Approach -- Records of annual peak discharges for small drainage areas are obtained from a crest-stage gage network. Selected crest-stage gage sites are equipped to collect simultaneous records of continuous rainfall and discharge. Long-term records of annual peak discharges are synthesized through the use of a rainfall-runoff model and a record of long-term rainfall. Data for large drainage areas are available from the regular stream-gaging network. Flood-frequency relations, determined by statistical methods, are extended to ungaged sites by using physical and climatic factors.

Reports -- See number 5 in "List of Reports...."

PROJECT TITLE: Streamflow characteristics

PROJECT NUMBER: KS-011

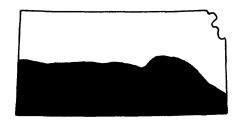
COOPERATING AGENCY: Kansas Water Office

PROJECT CHIEF: P. R. Jordan

<u>Problem --</u> There is a need to express basic streamflow records in more useful forms and to develop improved methods of estimating the frequency of various types of flow in gaged and ungaged streams in Kansas.

Objectives -- Define the significant characteristics of streamflow in Kansas; determine the interrelation between streamflow and ground-water storage; analyze and summarize existing data in useful terms for developing optimum benefit from the available water supplies and optimum protection from floods.

Approach -- Analyze significant streamflow characteristics and update results of previous studies using improved methods applied to initial data and additional data from 16 to 20 years of record, particularly the data from small drainage basins. Where available, improved analytical techniques will be used to determine flow probabilities.



PROJECT TITLE: Duties for the Kansas-Oklahoma Arkansas River Commission

PROJECT NUMBER: KS-041

COOPERATING AGENCY: Kansas-Oklahoma Arkansas River Commission

PROJECT CHIEF: E. R. Hedman

<u>Problem</u> -- The Kansas-Oklahoma Arkansas River Commission is composed of representatives of the States of Kansas and Oklahoma. The administration of the compact requires that certain water data be compiled and presented to the Commission.

Objectives -- Compilation of water data needed for the administration of the Arkansas River compact and performance of duties as Secretary-Treasurer for the Commission.

Approach -- Water data needed are collected as part of existing programs, and data are compiled, as required, and presented to the Commission. Duties of Secretary-Treasurer for the Commission are performed by the project chief.

PROJECT TITLE: Evaluation of the Ground-Water-Quality Monitoring Network

PROJECT NUMBER: KS-077

COOPERATING AGENCY: Kansas Department of Health and Environment

PROJECT CHIEFS: A. M. Diaz and T. B. Spruill

<u>Problem</u> -- Data on the chemical quality of ground water is needed from a statewide network of wells in response to State and Federal regulations imposed by the Safe Drinking Water Act of 1974 (Public Law 93-523). A continuing evaluation of the adequacy of the network is needed for monitoring ground-water quality in the principal aquifers of the State. These data are necessary for effective management decisions regarding the State's water resources.

Objective -- Evaluate the chemical-quality data to determine the adequacy of the network for describing baseline ground-water quality, to detect pollution of the principal aquifers in the State, and to determine the significance of the data in respect to State and Federal water-quality standards imposed by the Safe Drinking Water Act.

Approach -- Collect water samples for chemical analysis from a state-wide network of about 500 wells. The wells will be sampled to provide baseline data for determining the general chemical quality of ground water in the principal aquifers and to provide a basis for detecting possible long-term changes in regional ground-water quality. Interpretation of sampled data will continue, and the adequacy of data will be reanalyzed for detecting changes in chemical quality and in local occurrence of pollution.

Reports -- See numbers 38 and 39 in "List of Reports...."

PROJECT TITLE: Potential for liquid-waste injection into the Arbuckle

Group

PROJECT NUMBER: KS-078

COOPERATING AGENCY: Kansas Geological Survey

PROJECT CHIEF: J. E. Carr

<u>Problem</u> -- Rocks of the Arbuckle Group, which underlie nearly all of Kansas, are important oil reservoirs in much of the State and are an important freshwater aquifer in the southeastern part. The rocks also are a primary horizon for waste disposal, particularly oilfield brine. Little is known about the regional geohydrology and the potential effects of contamination to freshwater aquifers.

Objectives -- Determine the regional geohydrology of the Arbuckle Group from available data and further define the Arbuckle Group by making a preliminary assessment of the potential for waste injection to the aquifer. Determine the hydraulic characteristics and potential for liquid-waste injection at site-specific areas.

Approach -- Compile data to determine the areal extent and thickness of aquifers, the areal changes in hydraulic and chemical characteristics, and the configuration of the potentiometric surface of saline water in the Arbuckle and other aquifers. Observation wells will be installed at selected sites to monitor changes in head and chemical quality. Modeling techniques will be used to evaluate the potential for future injection and storage of liquid wastes and to assess the effects of waste injection on freshwater aquifers.

Reports -- See numbers 11 and 15 in "List of Reports...."



PROJECT TITLE: Kansas-Nebraska Big Blue River Compact

PROJECT NUMBER: KS-084

COOPERATING AGENCY: Federal PROJECT CHIEF: E. R. Hedman

<u>Problem</u> -- The Kansas-Nebraska Big Blue River Compact Administration insures equitable apportionment of waters of the Big Blue River between the states of Nebraska and Kansas.

Objective -- To administer the travel funds for the Federal Representative of the Compact.

<u>Approach</u> -- Travel costs incurred by Federal Representative are administered.



PROJECT TITLE: Techniques for estimating ground-water withdrawals in

western Kansas

PROJECT NUMBER: KS-090

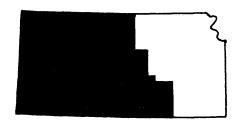
COOPERATING AGENCY: Kansas Water Office

PROJECT CHIEF: C. H. Baker, Jr.

<u>Problem</u> -- One of the principal unknown factors in quantitative ground-water hydrology and management of ground-water resources is the quantity of water withdrawn for irrigation use. The measurement of ground-water pumpage by installation of totalizing flow meters is possible but very expensive.

Objectives -- Investigate methods, other than metering of wells, for determining the withdrawal of ground water from irrigation wells in Kansas with an acceptable degree of accuracy and test such methods by application to a large irrigated area.

Approach -- The project is divided into two parts: Part 1 will be to list, describe, and evaluate different methods of obtaining discharges at a well site and for an area; Part 2 will be to field test any suitable method(s) evaluated in Part 1 on a large irrigated area, such as a ground-water management district.



PROJECT TITLE: High Plains regional aquifer-system analysis, western

Kansas

PROJECT NUMBER: KS-094 COOPERATING AGENCY: Federal PROJECT CHIEF: L. E. Stullken

Problem -- The Ogallala Formation is the principal aquifer underlying the High Plains. The aquifer contains about 2 billion acre-feet of water in storage, but water is being withdrawn for irrigation in excess of the rate of natural replenishment. The economic future of the High Plains in eight states, including Kansas, is dependent upon the capacity of the aquifer to sustain withdrawals. A detailed knowledge of the aquifer system is needed so that the system can be simulated, water-management alternatives evaluated, and the economic life of the aquifer projected.

Objective -- Previous studies of the hydrology of the High Plains have been limited by political boundaries. This study will provide a regional description of the water resources and the operation of the hydrologic system consistent with the natural hydrologic boundaries of the High Plains.

Approach -- Existing hydrologic data will be compiled and reviewed. Data-collection networks will be revised or initiated to provide adequate coverage for the study area. The data will be regionalized to provide a detailed description of the aquifer system and stored in a digital computer for processing and retrieval. Computer simulations of flow in the aquifer system will be made to evaluate additional data needs and add to knowledge of the system's flow characteristics.

<u>Reports</u> -- See numbers 29, 30, 31, 32, 40, 41, and 48 in "List of Reports..."

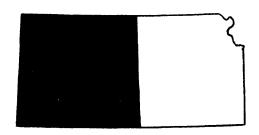
PROJECT TITLE: Central Midwest regional aquifer-system analysis, Kansas

PROJECT NUMBER: KS-111 COOPERATING AGENCY: Federal PROJECT CHIEF: R. J. Wolf

<u>Problem</u> -- The hydrology of the freshwater, brackish-water, and saline-water aquifer systems in rocks of Cambrian-Ordovician to Cretaceous ages is not well defined. Because of the increased demand for water from the overlying High Plains aquifer system in western Kansas, aquifers in this deeper rock system are being looked upon as a potential source of additional water supply. In addition, increased pumpage in eastern Kansas has caused saline-water encroachment into aquifers of this rock system. Added to these problems are those resulting from injection of industrial wastes and oilfield brine into these rocks.

Objectives -- Describe the hydrology of the freshwater, brackishwater, and saline-water aquifer systems in rocks of Cambrian-Ordovician to Cretaceous ages. Create a regional data base for the rock systems and describe present and potential problems associated with current and future water use. Evaluate the aquifer-system's response to future stresses.

Approach -- A search of the available literature will be made to determine the extent of geologic-framework interpretations and available data. Data will be collected to establish a data base of regional significance that will include detailed lithologic descriptions for selected wells, water-quality information, hydraulic characteristics of the rock systems, and information on water use, waste disposal, and brine injection. Appropriate maps will be prepared, and a steady-state digital model constructed to test the conceptual-flow system and to define additional data needs to calibrate a digital model capable of simulating the flow system for predictive purposes.



PROJECT TITLE: Determination of flood volume in small basins in western

Kansas using CSI peak discharge and storm depth-duration

PROJECT NUMBER: KS-113

COOPERATING AGENCY: Kansas Water Office

PROJECT CHIEF: C. A. Perry

<u>Problem</u> -- In western Kansas, there is a need for determining flood-flow volumes at locations other than those served by continuous-record gaging stations. Many smaller streams have crest-stage indicator (CSI) gages that provide measurement of peak discharge. If a relationship could be developed so that storm-runoff volumes could be evaluated from CSI peak discharges, useful estimates could be made for discharge volumes. This additional information on flood-flow volumes is needed for developing better generalized volume-frequency relations.

Objective -- Develop relationships among peak discharge, storm depth-duration, and observed streamflow volume for individual storms at continuous-record stations in a form that can be used to estimate flow volume for individual storms at CSI gages on small basins in western Kansas.

Approach -- Examine relationships between physical and climatic characteristics, rainfall depth-duration, and flood hydrographs at continuous-record stations. An effective base length will be determined using a triangular-hydrograph equation. Rainfall depth-duration determination will be improved by using average storm movement for the region. Multivariate regression techniques will be used to develop a predictive equation for calculating flood volumes at CSI sites.

PROJECT TITLE: High-flow volume-frequency relations for Kansas

PROJECT NUMBER: KS-116

COOPERATING AGENCY: Kansas Water Office

PROJECT CHIEF: P. R. Jordan

<u>Problem</u> -- Better information on high-flow volumes is needed as a basis for review of existing and planned reservoirs. Information based on adequate records of observed flows is superior to synthetic hydrographs based on estimated runoff relations and average storm patterns. State regulations require certain classes of new reservoirs to provide flood-control storage equal to the inflow volume of specified frequency. Inspection of existing reservoirs for safety must include consideration of the volumes of flood water they must store or pass through.

Objectives -- The study will provide high-flow volume information that can be used in design of new reservoirs and safety evaluation of existing reservoirs. Emphasis will be on small streams. The report will provide high-flow volume-frequency information at gaging stations throughout Kansas and will provide relations to basin characteristics that can be used for ungaged sites.

Approach -- The study will use available data from gaging stations with at least 10 years of record and drainage areas smaller than 3,000 square miles. Data on basin characteristics are available for these stations. High-flow volume frequency characteristics will be determined using WATSTORE program A969 and statistical curve fitting. Some study of skew coefficients will be needed for the curve fitting. A stepwise multiple-regression model then will be used to determine relations of high-flow volumes to basin characteristics.



PROJECT TITLE: Hydrology of Coal Area 40, Western Interior Coal Province,

Kansas, Oklahoma, and Missouri

PROJECT NUMBER: KS-121 COOPERATING AGENCY: Federal PROJECT CHIEF: J. F. Kenny

Problem -- Continued production of coal in the Western Interior Coal Province will require the stripping and reclamation of large land-surface areas. In recognizing the potentially adverse effects of coal mining on water resources, the Surface Mining Control and Reclamation Act of 1977 (Public Law 95-87) requires that comprehensive hydrologic information be provided on the general area prior to mining. This information is needed by surface-mine owners and operators and consulting engineers in the analysis of proposed mine sites and adjacent areas and by Federal and State regulatory agencies in appraising the adequacy of permit applications.

Objectives -- The U.S. Geological Survey is helping to provide data required by Public Law 95-87 through a series of reports covering the coal provinces nationwide. This study will provide broad hydrologic and related information and assess existing hydrologic conditions for Area 40 in southeastern Kansas, southwestern Missouri, and northeastern Oklahoma. Additional data needed to evaluate the impacts of strip mining on the water resources of Area 40 will be indicated, and extensive references to sources of more detailed information will be provided.

Approach -- Available data from previous and ongoing hydrologic investigations will be compiled by personnel from the Kansas and Oklahoma Districts. These data will be presented in a report consisting of a brief text with an accompanying map, chart, graph, or other illustration for each of a number of water-resources related topics. The summation of the topical discussions will provide a description of the hydrology of Area 40.

Research Projects

PROJECT TITLE: Development of distributed information systems

PROJECT NUMBER: KS-102 COOPERATING AGENCY: Federal PROJECT CHIEF: J. M. McNellis

<u>Problem</u> -- Increasing demand for information about water resources coupled with personnel ceilings works to prevent timely assessment and distribution of water data. Technology transfer in the computer area is slow to almost nonexistent, particularly for end users.

Objectives -- The primary objective is to demonstrate the feasibility of putting computer power in individual end-user hands. Technology transfer will accelerate among users, and timely assessment and distribution of water data will occur. District personnel will use the computer as a cost-effective tool in their jobs. A secondary objective is the development of an RFP (Request for Purchase) for acquisiton of minicomputers.

Approach -- A Harris minicomputer was installed in the Kansas District. This was an integral part of a prototype study on minicomputers. Kansas will implement ground-water flow models, automate rating analysis, read digital-punched tape with MITRON directly to the Harris, and numerous other applications. Coordination and exchange of software among Kansas, New Mexico, and Reston will be maintained. In addition to the testing, coordination, and exchange, the results and experience of having minicomputer systems in the hands of users will be utilized in writing an RFP for minicomputer acquisition.

PROJECT TITLE: Automatic Data Recorder Applications - Kansas

PROJECT NUMBER: KS-124

COOPERATING AGENCY: Federal PROJECT CHIEF: J. M. McNellis

<u>Problem</u> -- Applications resulting from using an Automatic Data Recorder (ADR) have been in the Survey program library for almost 20 years. These applications are currently processed via batch procedures in Reston. With state-of-the-art minicomputers, the potential for doing all the ADR processing on the local level is very high. The expense of developing application software requires that the ADR programs be readily transportable.

Objectives -- This project will produce computer programs, documentation, and procedures on the ADR applications. All the ADR techniques from WATSTORE will become transportable interactive programs written in FORTRAN 77 and made operational on the Harris minicomputer in Kansas.

Approach -- Items pertaining to the ADR processing, with emphasis on program E659, will be outlined. This outline will be the basis for definition of functions, processes, and computation procedures that comprise the suite of ADR program modules. Documentation and a flow chart of each module and of the complete ADR process will be developed as the FORTRAN 77 code is developed. Coordination with the Automatic Data Section during the project will be a continuing process.

LIST OF REPORTS APPROVED FOR PUBLICATION OR RELEASED DURING FISCAL YEARS 1981 AND 1982, KANSAS DISTRICT, U.S. GEOLOGICAL SURVEY

[Contact the District Office for information regarding the availability of these publications.]

- 1. Barker, R. A., Dunlap, L. E., and Sauer, C. A., 1981, Analysis and computer simulation of stream-aquifer hydrology, Arkansas River valley, southwestern Kansas: U.S. Geological Survey Open-File Report 81-686, 130 p.
- 2. Bevans, H. E., 1982, Water-quality and fluvial-sediment characteristics of selected streams in northeast Kansas: U.S. Geological Survey Water-Resources Investigations 82-4005, 53 p.
- 3. Carswell, W. J., Jr., 1981, Selected hydrologic relations for Soldier Creek, northeastern Kansas: U.S. Geological Survey Water-Resources Investigations 81-8, 68 p.
- 4. ____1982, Storage requirements to sustain gross reservoir outflow from small basins in Kansas: Kansas Water Office Technical Report No. 16, 40 p.
- 5. Clement, R. W., and Johnson, D. G., 1982, Flood of June 15, 1981, Great Bend and vicinity, central Kansas: U.S. Geological Survey Water-Resources Investigations 82-4123, 13 p.
- 6. Dunlap, L. E., 1982, Geohydrology of principal aquifers in the Republican River basin, Kansas: U.S. Geological Survey Open-File Report 82-79, 5 sheets.
- 7. Dunlap, L. E., and Spinazola, J. M., 1981a, Hydrologic maps of Ogallala aquifer, west-central Kansas: U.S. Geological Survey Open-File Report 81-908, 4 sheets.
- 8. _____1981b, Interpolating water-table altitudes in west-central Kansas using kriging techniques: U.S. Geological Survey Open-File Report 81-1062, 51 p.
- 9. Gillespie, J. B., and Hargadine, G. D., 1981, Saline ground-water discharge to the Smoky Hill River between Salina and Abilene, central Kansas: U.S. Geological Survey Water-Resources Investigations 81-43, 71 p.
- 10. Gogel, Tony, 1981a, Discharge of saltwater from Permian rocks to major stream-aquifer systems in central Kansas: Kansas Geological Survey Chemical Quality Series 9, 60 p.
- 11. _____1981b, Preliminary data from Arbuckle test wells, Miami, Douglas, Saline, and Labette Counties, Kansas: U.S. Geological Survey Open-File Report 81-1112, 155 p.

- 12. Gutentag, E. D., Lobmeyer, D. H., and Slagle, S. E., 1981, Geohydrology of southwestern Kansas: Kansas Geological Survey Irrigation Series 7, 73 p.
- 13. Hedman, E. R., and Osterkamp, W. R., 1982, Streamflow characteristics related to channel geometry in western United States: U.S. Geological Survey Water-Supply Paper 2193, 17 p.
- 14. Jordan, P. R., 1982, Rainfall-runoff relations and expected streamflow in western Kansas: Kansas Water Office Bulletin 25, 42 p.
- 15. Jorgensen, D. G., Gogel, Tony, and Signor, D. C., 1982, Determination of flow in aquifers containing variable-density water, <u>in</u> Ground Water Monitoring Review: Water Well Journal Publishing Co., Worthington, Ohio, v. 2, no. 2, Spring 1982, p. 40-45.
- 16. Jorgensen, D. G., Grubb, H. F., Baker, C. H., Jr., Hilmes, G. E., and Jenkins, E. D., 1982, A numerical model to evaluate proposed ground-water allocations in southwest Kansas: U.S. Geological Survey Water-Resources Investigations 82-4095, 46 p.
- 17. Jorgensen, D. G., and Stullken, L. E., 1981, Hydrology and model of North Fork Solomon River valley, Kirwin Dam to Waconda Lake, north-central Kansas: Kansas Geological Survey Irrigation Series 6, 34 p.
- 18. Kenny, J. F., Bevans, H. E., and Diaz, A. M., 1982, Physical and hydrologic environments of the Mulberry coal reserves in eastern Kansas: U.S. Geological Survey Water-Resources Investigations 82-4074, 50 p.
- 19. Kenny, J. F., and McCauley, J. R., 1982, Remote-sensing investigations in the coal fields of southeastern Kansas, chap. 29 of Remote sensing for resource management (outgrowth of a national conference by the same name, held October 28-30, 1980, at Kansas City, Mo., 665 p.): Soil Conservation Society of America, Ankeny, Iowa, p. 338-346.
- 20. Kume, Jack, and Spinazola, J. M., 1982, Geohydrologic data from sandstone aquifers in southwestern Kansas: U.S. Geological Survey Open-File Report 82-868, 112 p.
- 21. Lindgren, R. J., 1982, Determination of irrigation pumpage in parts of Kearny and Finney Counties, southwestern Kansas: U.S. Geological Survey Water-Resources Investigations 82-4011, 26 p.
- 22. McGovern, H. E., and Combs, L. J., 1981, Water-resources investigations of the U.S. Geological Survey in Kansas--Fiscal years 1979 and 1980: U.S. Geological Survey Water-Resources Investigations, Open-File Report 81-348, 107 p.

- 23. Osterkamp, W. R., Curtis, R. E., Jr., and Crowther, H. G., 1981, Sediment and channel-geometry investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado: U.S. Geological Survey Water-Resources Investigations, Open-File Report 81-128, 72 p.
- 24. Osterkamp, W. R., and Hedman, E. R., 1981, Channel geometry of regulated streams in Kansas as related to mean discharge, 1970-80: Kansas Water Office Technical Report No. 15, 32 p.
- 25. _____1982, Perennial-streamflow characteristics related to channel geometry and sediment in Missouri River basin: U.S. Geological Survey Professional Paper 1242, 37 p.
- 26. Osterkamp, W. R., Hedman, E. R., and Wiseman, A. G., 1982, Geometry, basin-characteristics, discharge, and particle-size data from gaged stream-channel sites, western United States: U.S. Geological Survey Hydrologic Data, Open-File Report 82-93, 56 p.
- 27. Pabst, M. E., 1981, January 1981 water levels, and data related to water-level changes, western and south-central Kansas: U.S. Geological Survey Open-File Report 81-1001, 168 p.
- 28. _____1982, January 1982 water levels and data related to waterlevel changes, western and south-central Kansas: U.S. Geological Survey Open-File Report 82-649, 167 p.
- 29. Pabst, M. E., and Stullken, L. E., 1981, Altitude and configuration of water table in High Plains aquifer in Kansas, 1980: U.S. Geological Water-Resources Investigations, Open-File Report 81-1004, 1 sheet.
- 30. ____1982a, Altitude and configuration of water table in High Plains aquifer in Kansas, 1960: U.S. Geological Survey Water-Resources Investigations, Open-File Report 82-429, 1 sheet.
- 31. ____1982b, Altitude and configuration of water table in High Plains aquifer, 1970: U.S. Geological Survey Water-Resources Investigations, Open-File Report 82-448, 1 sheet.
- 32. _____1982c, Altitude and configuration of water table in High Plains aquifer, 1965: U.S. Geological Survey Water-Resources Investigations, Open-File Report 82-449, 1 sheet.
- 33. Pope, L. M., and Diaz, A. M., 1982, Quality-of-water data and statistical summary for selected coal-mine strip pits in Crawford and Cherokee Counties, southeastern Kansas: U.S. Geological Survey Open-File Report 82-1021, 28 p.
- 34. Reed, T. B., 1981, Map of water table in Solomon River valley, Waconda Lake to Solomon, north-central Kansas, May, 1980: U.S. Geological Survey Water-Resources Investigations, Open-File Report 81-334, 1 sheet.

- 35. Spinazola, J. M., 1981, Map of water table in Graham County, northwestern Kansas, March 1979: U.S. Geological Survey Water-Resources Investigations, Open-File Report 81-333, 1 sheet.
- 36. 1982a, Hydrologic maps of the Ogallala aquifer, west-central Kansas, 1979-81: U.S. Geological Survey Open-File Report 82-258, 4 sheets.
- 37. _____1982b, Hydrologic maps of the High Plains aquifer, January 1981, southwestern Kansas: U.S. Geological Survey Water-Resources Investigations 82-4079, 8 sheets.
- 38. Spruill, T. B., 1982, Nitrate-nitrogen concentrations in ground water from three selected areas in Kansas: U.S. Geological Survey Water-Resources Investigations 82-11, 32 p.
- 39. Spruill T. B., and Kenny, J. F., 1981, Location of sampling sites and available information on wells sampled in the Kansas Ground-Water-Quality Monitoring Network, 1976-80: U.S. Geological Survey Hydrological Data, Open-File Report 81-925, 49 p.
- 40. Stullken, L. E., and Pabst, M. E., 1981, Altitude and configuration of water table in High Plains regional aquifer system of Kansas, 1975: U. S. Geological Survey Water-Resources Investigations, Open-File Report 81-144, 1 sheet.
- 41. _____1982, Altitude and configuration of water table in High Plains aquifer of Kansas, pre-1950: U.S. Geological Survey Water-Resources Investigations, Open-File Report 82-117, 1 sheet.
- 42. U.S. Geological Survey, 1981a, Flood insurance study, city of Manhattan, Kansas: Federal Emergency Management Agency, Federal Insurance Administration, U.S. Department of Housing and Urban Development.
- 43. 1981b, Flood insurance study, city of Ogden, Kansas: Federal Emergency Management Agency, Federal Insurance Administration, U.S. Department of Housing and Urban Development.
- 44. ____1981c, Flood insurance study, Riley County, Kansas: Federal Emergency Management Agency, Federal Insurance Administration, U.S. Department of Housing and Urban Development.
- 45. 1981d, Water resources data for Kansas, water year 1980--volume
 1. Missouri River basin: U.S. Geological Survey Water-Data
 Report KS-80-1, 422 p.
- 46. _____1981e, Water resources data for Kansas, water year 1980--volume 2. Arkansas River basin: U.S. Geological Survey Water-Data Report KS-80-2, 340 p.
- 47. _____1982, Water resources data for Kansas, water year 1981: U.S. Geological Survey Water-Data Report KS-81-1, 566 p.
- 48. Watts, K. R., and Stullken, L. E., 1981, Generalized configuration of the base of the High Plains aquifer in Kansas: U.S. Geological Survey Water-Resources Investigations, Open-File Report 81-344, 1 sheet.

HYDROLOGIC-DATA STATIONS IN KANSAS, 1982 WATER YEAR

Explanation of Table Symbols

Surface-Water Stations

Station Purpose, Complete-Record Gaging Stations

- B Benchmark.
- C Current purpose station.
- F Flood forecast (also used by National Weather Service).
- H A hydrologic station to meet objectives of defining regional streamflow characteristics.
- I Interstate Compact.
- L Long-term trend station or drought index station.
- P Principal-stream station to meet objectives of measuring principal unregulated streams.
- R A station required for systems analysis of a regulated stream to meet objective of defining regulated flow.

Type of Gage, Complete-Record Gaging Station

- B Bubble gage R Graphic recorder
- C Cableway T Telemetering equipment
- D Digital recorder (stage) W Artificial control
- Dp Digital recorder (precipitation)

Sampling Purpose, Water-Quality Stations

- CHEM Chemical analysis: cations, anions, nutrients
- METAL Trace metals analysis
- BIOL Biological analysis: phytoplankton, periphyton
- TOC Total organic carbon determination
- RAD Radiochemical analysis
- PEST Pesticide analysis
- SED Suspended sediment: concentration, discharge, particle size
- BED Bed material: particle size
- COLI Coliform count: total, fecal, fecal streptococcal
- FIELD Field measurements: discharge, water temperature, alkalinity, conductance, pH, dissolved oxygen
- OBS Field observer collects samples for conductance, chloride, and water temperature

Cooperator or Supporting Program

ARCA Arkansas River Compact Administration
BENCHMARK Hydrologic Benchmark Program (Federal)
CBR Collection of Basic Records (Federal)

DWR Kansas State Board of Agriculture, Division of Water Resources

HAYS City of Hays

KC-CE Kansas City District, U.S. Army Corps of Engineers

KDHE Kansas Department of Health and Environment

KDOT Kansas Department of Transportation

KWO Kansas Water Office

MRB Missouri River Basin Program (Federal)

NASQAN National Stream-Quality Accounting Network (Federal)

OFA Other Federal Agencies

T-CE Tulsa District, U.S. Army Corps of Engineers

USBR U.S. Bureau of Reclamation

WICHITA City of Wichita

Ground-Water Wells

Well Numbers

Well numbers in these listings indicate the location of wells according to the land subdivisions of the U.S. Bureau of Land Management (fig. 9). An example of a typical well number is 12S O6E O6BCAC in Geary County. The first two digits indicate the township, which in Kansas are nearly all south of the 40th parallel base line. The second two digits indicate the range east or west of the Sixth Principal Meridian. last two digits indicate the section in which the well is located. first letter after those digits denotes the quarter section or 160-acre tract; the second, the quarter-quarter section or 40-acre tract; the third, the quarter-quarter section or 10-acre tract; and the fourth, when used, the quarter-quarter-quarter-quarter section or 2 The quarter sections, quarter-quarter sections, and so 1/2-acre tract. forth, are designated \underline{A} , \underline{B} , \underline{C} , and \underline{D} in a counterclockwise direction, beginning with A in the northeast quadrant. If two or more wells are located within the smallest subdivision indicated, the wells are numbered serially.

Water-Level Notes

A - Annual observation

M - Monthly observation

Q - Quarterly observation

R - Continuous recorder

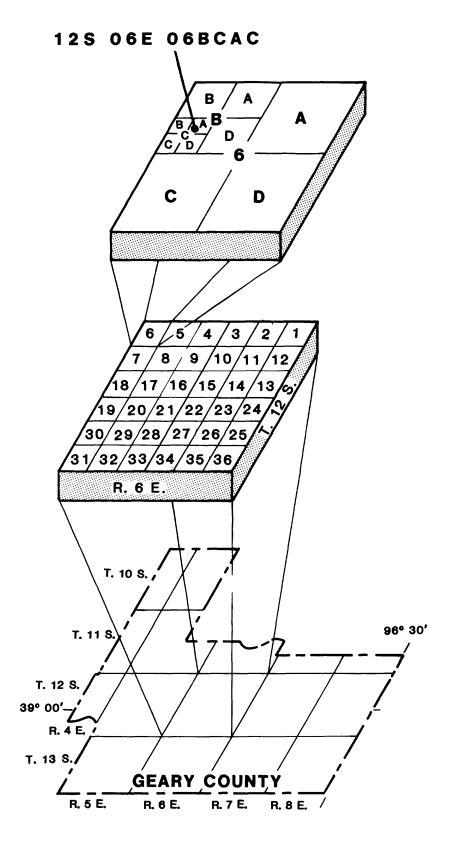


Figure 9.--Well-numbering system.

Table 1.--Complete-record surface-water gaging stations, 1982 water year

Ident.	Station name	Station	Location			Туре	Coop.
		purpose	Sec.	τ.	R.	of gage	or support
	Missouri	River Ba	sin				
06-							
8140 8447 8449 8465 8479	Turkey Cr. nr Seneca S. Fk. Sappa Cr. nr Brewster S. Fk. Sappa Cr. nr Achilles Beaver Cr. at Cedar Bluffs Prairie Dog Cr. ab Keith Sebelius Lake	C,F,L,P H,L H,L C,I,L,P C,L,P	20 9 29 10 23	1S 9S 4S 1S 3S	12E 37W 30W 29W 25W	BDR DRDp DRDp BDR BCDRDpW	KWO KWO CBR KC-CE
	Keith Sebelius Lake nr Norton		8	35	23W	BR	KWO
8480 8485	Prairie Dog Cr. at Norton Prairie Dog Cr. nr Woodruff	C,R C,I,L,R	9 9	3S 1S	23W 19W	BDRW BDR	KWO CBR
8535 8538	Republican R. nr Hardy, Nebr. White Rock Cr. nr Burr Oak		6 7	1S 2S	5W 8W	BDRT BCDRW	CBR KC-CE
8539	Lovewell Res. nr Lovewell		6	2\$	6W	BR	KWO
8540 8558	White Rock Cr. at Lovewell Buffalo Cr. nr Jamestown	C,R C,F	17 14	2S 5S	6W 5W	BDRW BDR	KWO KWO
8560 8566	Republican R. at Concordia Republican R. at Clay Center	C,R C,R	28 17	5S 8S	3W 3E	BDRT BDRT	KC-CE CBR
	Milford Lake nr Junction City		20	115	5E	RT	KC-CE
8571 8585	Republican R. bl Milford Dam N. Fk. Smoky Hill R. nr McAllaster	C,R F,P	17	12S	36W	BCDRT BDRDp	KC-CE
8600 8610	Smoky Hill R. at Elkader Smoky Hill R. nr Arnold	C,L,P C,P	34 29	14S 14S	32W 24W	BDRDp BDR	KC-CE
8615 8620	Cedar Bluff Res. nr Ellis Smoky Hill R. at Cedar Bluff	C,R	36 1	14S 15S	22W 22W	BR BCRTW	KWO KWO
8627 86285 8635	Dam Smoky Hill R. nr Schoenchen Smoky Hill R. bl Schoenchen Big Cr. nr Hays	C,F,R C,R C,F,L	25 27 30	15S 15S 14S	19W 18W 17U	BDR BDR BDR	KWO HAYS KWO
8639 86405 8645	N. Fk. Big Cr. nr Victoria Smoky Hill R. nr Bunker Hill Smoky Hill R. at Ellsworth	C,L C,R C,R	27 33 20	13S 14S 15S	17W 13W 8W	BR BDR BDR	KWO KC-CE KC-CE
8650 8655	Kanopolis Lake nr Kanopolis Smoky Hill R. nr Langley	C,R	3 35	17S 16S	6W 6W	BR BDRT	KC-CE KC-CE

Table 1.--Complete-record surface-water gaging stations, 1982 water year-Continued

Ident.	Station name	Station	Location			Type	Coop.
no.		purpose	Sec.	Т.	R.	of gage	or support
06-							
8665	Smoky Hill R. nr Mentor	C,R	29	145	2W	BDRT	KC-CE
8669 8670	Saline R. nr WaKeeney Saline R. nr Russell	H,P C,F,L	34	11S 12S	23W 14W	BDR BDR	KWO KWO
8681	Wilson Lake nr Wilson	() 9 9 L	36	125	1 1 W	RT	KC-CE
8682	Saline R. at Wilson Dam	C,R	25	125	11W	BDRT	KC-CE
8695	Saline R. at Tescott	C,F,R	16	12 S	5W	BDRT	KWO
8702	Smoky Hill R. at New Cambria	C,R	1	145	2W	BDR	MRB
8710 8715	N. Fk. Solomon R. at Glade Bow Cr. nr Stockton	C,P C,F,L	25 1	4S 6S	18W 18W	BDR BDR	KC-CE KWO
8717	Kirwin Res. at Kirwin	U, F, L	33	45	16W	BR	KWO
8718	N. Fk. Solomon R. at Kirwin	C,R	33	48	16W	R	KWO
8725	N. Fk. Solomon R. at Portis	C,R	5	68	12W	BDR	KC-CE
8730	S. Fk. Solomon R. ab Webster Res.	C,P	8	88	20W	BDR	KC-CE
8731	Webster Res. nr Stockton		27	7\$	19W	BR	KWO
8732	S. Fk. Solomon R. bl Webster Res.	C,R	26	7 S	19W	BCDR	KW0
	S. Fk. Solomon R. at Woodstor	ı C,R	16	7 S	16W	BDR	USBR
8740		C,F,R	20	7S	12W	BDR	KW0
8742 8759	Waconda Lake at Glen Elder Solomon R. nr Glen Elder	C,F,R	27 2	6S 7S	9W 9W	BR BCDRW	USBR KWO
	Solomon R. nr Minneapolis	C,R	1	115	4W	BDR	USBR
8767	Salt Cr. nr Ada	C,F	36	105	5W	BDR	KWO
8769	Solomon R. at Niles	C,R	31	125	1W	BDRT	KC-CE
8776 8780	Smoky Hill R. at Enterprise Chapman Cr. nr Chapman	C,R F,L	20 1	13S 12S	3E 3E	BDRT BDR	KC-CE KWO
8791	Kansas R. at Ft. Riley	C,R	33	115	6E	BDRT	KC-CE
87965	Kings Cr. nr Manhattan	В	18	115	8E	BCDRDp	CBR
8842	Mill Cr. at Washington	F,H	1	3 S	3E	BDR	KWO
	Little Blue R. nr Barnes	C,P	22	35	5E	BDR	KC-CE
8855	Black Vermillion R. nr Frankfort	C,P	20	45	9E	BDR	KC-CE
8869	Tuttle Creek Lake nr Manhattan		24	9\$	7E	BR	KC-CE
8870	Big Blue R. nr Manhattan	C,R	30	98	8E	BDRT	KC-CE
8875	Kansas R. at Wamego	C,R	9	105	10E	BDRT	KC-CE
8885 8890	Mill Cr. nr Paxico Kansas R. at Topeka	C,F,L C,R	27 28	11S 11S	11E 16E	BDRT BDRT	KWO KC-CE
	Kansas R. nr Belvue	C	13	105	11E	BDRT	DWR

Table 1.--Complete-record surface-water gaging stations, 1982 water year-Continued

Ident. no.		Station	Lo	Location			Coop.
		purpose	Sec.			Type of	or
			····			gage	support
06-							
8891	Soldier Cr. nr Goff	C,H	16	5S	13E	BDRDp	KWO
88912	Soldier Cr. nr Bancroft	C,H	28	58	13E	BDRDp	KWO
88914	Soldier Cr. nr Soldier	C,H	4	68	13E	BDRDp	KWO
88916	Soldier Cr. nr Circleville	C,H	10	7S	13E	BDRDp	KWO
8892	Soldier Cr. nr Delia	C,H	8	105	14E	BDR	KWO
0032	Soluter Cr. III Della	ااون	O	103	146	DUK	KWU
8895	Soldier Cr. nr Topeka	C,P	14	11S	15E	BDR	KC-CE
8901	Delaware R. nr Muscotah	C,L	16	68	17E	BDRT	KC-CE
	Perry Lake nr Perry	- 3 -	9	115	18E	R	KC-CE
8909	Delaware R. bl Perry Dam	C,R	9	115	18E	CR	KC-CE
8910	Kansas R. at Lecompton	C,R	35	115	18E	BDRT	KC-CE
0310	Ransas N. at Lecompton	UgK	30	113	TOE	DUKI	NU-UE
891478	Clinton Lake nr Lawrence		8	13S	19E	BR	KC-CE
8915	Wakarusa R. nr Lawrence	C,R	23	13S	19E	BDRT	KC-CE
8920	Stranger Cr. nr Tonganoxie	C,L	7	118	22E	BDRT	KC-CE
	Kansas R. at DeSoto	C,F,R	28	125	22E	BDRT	KWO/KC
89308	Blue R. nr Stanley	C,H	19	145	25E	BDR	KWO
03300	blue R. III Stanley	0 9 11	19	143	236	DUK	NNU
8933	Indian Cr. at Overland Park	C,H	6	13 S	25E	BDR	KWO
89335	Tomahawk Cr. nr Overland Par	k C.H	21	135	25E	BDR	KWO
9108	Marais des Cygnes R. nr Reading	C,P	15	175	13E	BDR	KC-CE
910997	Melvern Lake nr Melvern		1	185	15E	R	KC-CE
9115	Salt Cr. nr Lyndon	C,F,L	34	168	16E	BDR	KWO
7113	Sait Cr. III Lyndon	ے واوں	34	103	101.	DUK	KWU
9119	Dragoon Cr. nr Burlingame	C,H	27	15 S	14E	BDR	KC-CE
91249	Pomona Lake nr Quenemo	-	19	165	17E	R	KC-CE
9125	Hundred and Ten Mile Cr. nr	C,R	20	165	17E	BCDRT	KC-CE
9130	Quenemo Marais des Cygnes R. nr	C,R	7	175	18E	BDRT	KC-CE
9135	Pomona Marais des Cygnes R. nr	C,R	36	168	19E	BDRT	KC-CE
9135		C,R	36	168	19E	BNRT	KC-CE
9140	Pottawatomie Cr. nr Garnett	C,F,L	6	20\$	20E	BDR	KWO
	Hillsdale Lake nr Hillsdale		17	168	23E	BR	KC-CE
9150	Big Bull Cr. nr Hillsdale	C,R	20	165	23E	BCDR	KC-CE
9166	Marais des Cygnes R. nr	C,R	16	218	25E	BDRT	KWO
3100			10	۷13	Z 3E	DUKI	KWU
0170	Kansas-Missouri State Lin		0.5	000	04-	000=	1/1.40
9170	Little Osage R. at Fulton	C,F,L	25	235	24E	BDRT	KWO
91738	Marmaton R. nr Marmaton	C,F,L	4	268	24E	BCDR	KC-CE

Table 1.--Complete-record surface-water gaging stations, 1982 water year-Continued

Ident.		Station purpose	Lo Sec.	catio T.	R.	Type of gage	Coop. or support
	Arkansas	River Bas	in				
1370 1375 1380	Frontier Ditch nr Coolidge Arkansas R. nr Syracuse Arkansas R. at Syracuse	C,I C,I,R C,F,R	21 26 18	23S 23S 24S	43W 43W 40W	BDRTW BDRT BDRDpT	CBR CBR KWO
13865	Whitewoman Cr. nr Leoti	C,H	23	185	38W	BRDp	KWO
1395 1398 1400 14085 1412	Arkansas R. at Dodge City Mulberry Cr. nr Dodge City Arkansas R. nr Kinsley Pawnee R. nr Burdett Pawnee R. nr Larned	C,R C,H,L,P C,R H,L,P C,F,L,P	35 24 26 21 30	26S 28S 24S 21S 21S	25W 25W 19W 21W 18W	BDRT BDR BDRT BDR BDRW	T-CE/CBR KWO T-CE KWO KWO
1413 14178 1419 1423 142575	Arkansas R. at Great Bend Walnut Cr. nr Rush Center Walnut Cr. at Albert Rattlesnake Cr. nr Macksvill Rattlesnake Cr. nr Zenith	C,R C,H,P C,L,P H,P H,P	33 24 29 16 26	19S 18S 18S 25S 22S	13W 19W 15W 14W 11W	BDRT BDR R BDR BDR	T-CE KWO KWO KWO KWO
1433 14333	Rattlesnake Cr. nr Raymond Cow Creek nr Lyons Arkansas R. nr Hutchinson Little Ark. R. at Alta Mills Little Ark. R. Floodway at Valley Center	H,P C,F,L,R C,F,R H,P	15 15 21 30 34	21S 20S 24S 22S 25S	10W 8W 4W 2W 1W	BDR BDRT BDR BDR BR	KWO KWO WICHITA
1442	Little Ark. R. at Valley Center (main stem)	C,L	36	25S	1W	BDR	KWO
1443	Arkansas R. Floodway at Wichita		11	275	1W	BR	WICHITA
1443	Arkansas R. at Wichita (main stem)	C,F,P	5	28\$	1E	BDRT	KWO
14455 14478	Arkansas R. at Derby N. Fk. Ninnescah R. ab Cheney Reservoir	C,P C,P	12 25	29S 25S	1E 6W	BDRT BDR	T-CE WICHITA
	Cheney Reservoir nr Cheney N. Fk. Ninnescah R. at Cheney Dam	C,R	6 6	27S 27S	4W 4W	BR D W	WICHITA WICHITA
14491 1452	S. Fk. Ninnescah R. nr Pratt S. Fk. Ninnescah R. nr Murdock	H,P C,F,L	2 34	28S 28S	13W 5W	BDR BDR	KWO KWO
1455 1 4 57	Ninnescah R. nr Peck Slate Creek at Wellington	C,R H,P	10 23	30S 32S	1W 1W	BDRT BDR	T-CE KWO

Table 1.--Complete-record surface-water gaging stations, 1982 water year-Continued

Ident.	Station name	Station purpose		ocati T.	on R.	Type of gage	Coop. or support
07-							
1465	Arkansas R. at Arkansas City	C,L,P	35	345	3E	BDRT	T-CE/CBR
146622	El Dorado Lake nr El Dorado	C,R	30	25 S	6E	RT	T-CE
146623	Walnut R. bl El Dorado Lake	C,R	25	258	5E	RT	T-CE
14683	Walnut R. at Hwy. 54 east of El Dorado	C,R	1	26S	5E	BDRT	T-CE
146895	Walnut R. at Augusta	C,R	27	27 S	4E	BDRT	T-CE
14707	Whitewater R. at Towanda	C,F,P	8	268	4E	BDRT	KWO
1478	Walnut R. at Winfield	C	33	325	4E	BDRT	T-CE
1490	Medicine Lodge R. nr Kiowa	L,P	36	345	11W	BDR	KWO
1515	Chikaskia R. nr Corbin	F,P	36	33S	3W	BDR	KWO
15559	Cimarron R. nr Elkhart	Н	4	345	42W	BR	KWO
15601	N. Fk. Cimarron R. at Richfield	Н	16	325	41W	BR	KWO
1561	Sand Arroyo Cr. nr Johnson	Н	25	29 S	41W	BDRDp	KWO
15622	Bear Cr. nr Johnson	Н	12	285	4 1W	BDR	KWO
1575	Crooked Cr. nr Nye	F,L	1	35\$	27W	BDR	KWO
1659	Toronto Lake nr Toronto		36	26 S	13E	R	T-CE
1660	Verdigris R. nr Coyville	C,R	8	275	14E	DR	T-CE
1665	Verdigris R. nr Altoona	C,R	29	298	16E	DRT	T-CE
1675	Otter Cr. at Climax	H,L	8	275	11E	BDR	KWO
1680	Fall River Lake nr Fall Rive		3	285	12E	BR	T-CE
1685	Fall R. nr Fall River	C,R	2	285	12E	DRT	T-CE
1695	Fall R. at Fredonia	C,R	24	29\$	14E	DRT	T-CE
1698	Elk R. at Elk Falls	C,H	3	315	11E	BDR	KWO
17005	Elk City Lake nr Independenc		9	325	15E	BR	T-CE
17006	Elk R. bl Elk City Lake	C,R	9	325	15E	BDR	T-CE
1705	Verdigris R. at Independence	C,R	32	325	16E	BDRT	T-CE
170695	Big Hill Lake nr Cherryvale		7	325	18E	BR	T-CE
1707	Big Hill Cr. nr Cherryvale	C,H	7	325	18E	BDRT	T-CE
1720	Caney R. nr Elgin	C,L	16	358	10E	BDR	KWO
1794	Council Grove Lake nr Council Grove		10	168	8E	BR	T-CE
1795	Neosho R. at Council Grove	C,R	14	165	8E	DR	T-CE
17973	Neosho R. nr Americus	C,R	24	18\$	10E	BDRT	T-CE
179794	Marion Lake nr Marion		27	198	3E	BR	T-CE
179795	Cottonwood R. bl Marion Lake	C,R	27	198	3E	BCDR	T-CE
1804	Cottonwood R. nr Florence	C,R	10	215	5E	BDRT	T-CE
1805	Cedar Cr. nr Cedar Point	C,L	25	215	5E	DR	KW0

Table 1.--Complete-record surface-water gaging stations, 1982 water year-Continued

Ident. no.	Station name	Station purpose		ocati T.	R.	Type of gage	Coop. or support
07-							
18225	Cottonwood R. nr Plymouth	C,R	13	198	9E	BDRT	T-CE
18245	John Redmond Res. nr Burlington	-	9	21S	15E	BRT	T-CE
18251	Neosho R. at Burlington	C,R	26	218	15E	BDRT	T-CE
1830	Neosho R. nr Iola	C,R	9	25 S	18E	BCDRT	T-CE
1835	Neosho R. nr Parsons	C,F,R	33	315	21E	BDRTW	KWO
1840	Lightning Cr. nr McCune	H,L,P	7	325	22E	BDR	KWO
1843	Cherry Creek nr Hallowell	C	21	335	22E	BDR	KWO
18604	Cow Creek nr Weir	С	33	318	25E	BDR	KWO

Table 2.--Partial-record surface-water gaging stations, 1982 water year

Crest-Stage Gage

Ident.	0	•		_	Coop
no.	Station name	Sec.	cation T.	R.	or support
	Missouri R	iver B	asin		
06-					
8137	Tennessee Cr. trib. nr Seneca	2	3 S	12E	KDOT
8157	Buttermilk Cr. nr Willis	30	35	18E	KDOT
81826	White Clay Cr. at Atchison	1	68	20E	KC-CE
8448	S. Fk. Sappa Cr. trib. nr Goodland	36	8S	39W	KDOT
8451	Long Branch Draw nr Norcatur	6	2S	25W	KDOT
8460	Beaver Cr. at Ludell	30	2 S	32W	KWO
8462	Beaver Cr. trib. nr Ludell	2	3S	32W	KDOT
8476	Prairie Dog Cr. trib. at Colby	6	88	33W	KDOT
8482	Prairie Dog Cr. trib. nr Norton	26	2S	23W	KDOT
8561	West Cr. nr Talmo	36	45	3W	KDOT
85632	Elk Cr. at Clyde	26	5S	1W	KC-CE
8568	Moll Cr. nr Green	8	88	4E	KDOT
8605	Hackberry Cr. nr Gove	1	13S	29W	KWO
8630	Smoky Hill r. at Pfeifer	30	1 5S	16W	KC-CE
8634	Big Cr. trib. nr Ogallah	11	135	22W	KDOT
8637	Big Cr. trib. nr Hays	7	14 S	17W	KDOT
8643	Smoky Hill R. trib. at Dorrance	12	145	12W	KDOT
8647	Spring Cr. nr Kanopolis	24	15 S	8W	KDOT
86649	Dry Cr. at Mentor	24	15 S	3W	KC-CE
8668	Saline R. trib. at Collyer	32	118	25W	KDOT
8683	Coon Cr. trib. nr Luray	19	1 0S	12W	KDOT
8684	Wolf Cr. nr Lucas	33	118	11W	KWO
8689	Bullfoot Cr. trib. nr Lincoln	30	125	7W	KDOT
86995	Mulberry Cr. nr Salina	9	145	3W	KC-CE
8703	Gypsum Cr. nr Gypsum	15	1 6S	1W	KWO
8726	Oak Cr. at Bellaire	15	3S	12W	KDOT
8733	Ash Cr. trib. nr Stockton	18	7 S	18W	KDOT
8745	East Limestone Cr. nr Ionia	21	45	9W	KDOT
8758	Limestone Cr. nr Glen Elder	15	6S	9W	KWO
87712	Mud Cr. at Abilene	17	135	2E	KC-CE

Table 2.--Partial-record surface-water gaging stations, 1982 water year--Continued

Ident.					Соор
no.	Station name	Location			or
		Sec.	Τ.	R.	support
)6 -					
8775	Turkey Cr. nr Abilene	26	14 S	2E	KWO
8792	Clark Cr. nr Junction City	14	12 S	6E	KWO
87981	5 Wildcat Cr. at Manhattan *	14	108	7E	KWO
8841	Mulberry Cr. trib. nr Haddam	10	3S	1E	KDOT
8843	Mill Cr. trib. nr Washington	5	3\$	4 E	KDOT
8849	Robidoux Cr. at Beattie	20	2S	9E	KDOT
88549	Black Vermillion R. at Frankfort (Hwy 99)	16	4 S	9E	KC-CE
8865	Fancy Cr. at Winkler	2	7S	5E	KWO
8872	Cedar Cr. nr Manhattan	19	9 S	8E	KDOT
8876	Kansas R. trib. nr Wamego	14	105	10E	KDOT
8880	Vermillion Cr. nr Wamego	20	88	11E	KC-CE
88803		12	9\$	10E	KC-CE
8883	Rock Cr. nr Louisville	14	9 S	9E	KWO
8889	Blacksmith Cr. trib. nr Valencia	11	125	14E	KDOT
88955	Indian Cr. nr Topeka	5	115	16E	KC-CE
88963	Shunganunga Cr. at Topeka	6	125	16E	KC-CE
89105	Stone House Cr. at Williamstown	30	118	19E	KDOT
89169	Naismith Cr. at Lawrence	12	138	19E	KWO
89189	Stranger Cr. at Easton	19	88	21E	KC-CE
8928	Turkey Cr. at Merriam	13	125	2 4 E	KWO
89294	Turkey Cr. at Kansas City	27	115	25E	KWO
9123	Dragoon Cr. trib. nr Lyndon	6	16S	16E	KDOT
9137	Middle Cr. nr Princeton	13	18S	19E	KDOT
91425	S. Fk. Pottawatomie Cr. trib. nr Garnett	7	215	20E	KDOT
9145	Pottawatomie Cr. at Lane	34	18\$	21 E	KC-CE
9151	Big Bull Cr. at Paola	17	175	23E	KC-CE
9167	Middle Cr. nr Kincaid	11	235	20E	KDOT
9171	Marmaton R. nr Bronson	3	25S	21E	KDOT
9174	Marmaton R. trib. nr Fort Scott		26 S	24E	KDOT

Table 2.--Partial-record surface-water gaging stations, 1982 water year-Continued

Ident. no.	Station name	Location Sec. T. R.			Coop or support
	Arkansas Ri	ver f	Rasin		
17	Williams Wi	VCI I	λα 3 111		
07 - 1386	Whitewoman Cr. trib. nr Selkirk	34	175	39W	KDOT
1390	Arkansas R. at Garden City	19	245	32W	KWO
1397	Arkansas R. trib. nr Dodge City		275	25W	KDOT
1403	Whitewoman Cr. nr Bellefont	33	245	21W	KDOT
1406	Pawnee R. trib. nr Kalvesta	12	235	28W	KDOT
1416	Lana Bassah Carras Naga City	20	100	0.014	VDOT
1416	Long Branch Cr. nr Ness City	32	185	23W	KDOT
1418	Otter Cr. nr Rush Center	15	198	18W	KDOT
1421	Rattlesnake Cr. trib. nr Mullinville	20	28S	19W	KDOT
1427	Salt Cr. nr Partridge	22	23S	7W	KDOT
1429	Blood Cr. nr Boyd	34	175	14W	KWO
14286	Cow Cr. nr Claflin	6	185	11W	KWO
1431	Cheyenne Cr. trib. nr Claflin	28	185	1 1W	KDOT
1436	Little Arkansas R. nr Little River	8	195	6W	KWO
1449	S. Fk. Ninnescah R. trib. nr Pratt	27	27S	13W	KDOT
1453	Clear Cr. nr Garden Plain	33	275	3W	KDOT
1458	Antelope Cr. trib. nr Dalton	11	325	1E	KDOT
14702	Whitewater R. trib. nr Towanda	26	25 S	3E	KDOT
14799	Cedar Cr. trib. nr Cambridge	26	318	7E	KDOT
1481	Grouse Cr. nr Dexter	31	325	7E	KWO
1516	Rush Cr. nr Harper	21	325	7W	KDOT
1559	N. Fk. Cimarron R. trib. nr Elkhart	9	33\$	42W	KDOT
1566	Cimarron R. trib. nr Moscow	20	31S	34W	KD0T
1567	Cimarron R. trib. nr Satanta	17	325	33W	KDOT
1571	Crooked Cr. nr Copeland	36	28S	30W	KDOT
1574	Crooked Cr. trib. at Meade	2	325	28W	KDOT
1577	Kiger Cr. nr Ashland	3	335	24W	KDOT
1579	Cavalry Cr. at Coldwater	14	32S	19W	KWO
1662	Sandy Cr. nr Yates Center	26	25S	14E	KDOT
1708	Mud Cr. nr Mound Valley	9	33S	14E 18E	KDOT KDOT
1708		7			
1/1/	Spring Branch nr Cedar Vale	/	345	9E	KDOT

Table 2.--Partial-record surface-water gaging stations, 1982 water year---Continued

Ident. no.	Station name	Lo Sec.	ocation T.	n	Coop or support
07-					
1718	Cedar Cr. trib. nr Hooser	7	345	8E	KDOT
1803	Spring Cr. trib. nr Florence	32	215	5E	KDOT
1815	Middle Cr. nr Elmdale	13	198	6E	KWO
1826	N. Big Cr. nr Burlington	27	225	15E	KDOT
1838	Limestone Cr. nr Beulah	28	30S	23E	KDOT
1845	Labette Cr. nr Oswego	11	33S	20E	KWO
	Low-Flow	w Gage	:		
	Arkansas R	iver B	asin		
07-					
14257	Rattlesnake Cr. ab. Little Salt Marsh nr Hudson	31	225	11W	KWO
14265	Peace Cr. nr Sylvia	4	235	10W	KWO
14267	Peace Cr. nr Sterling	7	22 S	8W	KWO
14274	Salt Cr. nr Hutchinson	1	23S	7W	KWO
14459	N. Fk. Ninnescah R. nr Sylvia	27	245	10W	KWO
14462	N. Fk. Ninnescah R. ab Silver Cr. nr Arlington	25	25S	8W	KWO
14464	Silver Cr. nr Landon	8	26S	9W	KWO
14489	S. Fk. Ninnescah R. at Pratt	3	28\$	13W	KWO
14513	S. Fk. Ninnescah R. nr Calista	1	27 S	9W	KWO
	Continuous-Sta	age Re	corder	•	
	Missouri R	iver B	asin		
06-					
8785	Lyon Cr. nr Woodbine	31	13S	5E	KC-CE
87982	Kansas R. at Manhattan	27	10S	8E	KC-CE
8847	Big Blue R. nr Blue Rapids	21	45	7E	KC-CE
89295	Kansas R. at Kansas City	14	118	25E	KC-CE
9114	Marais des Cygnes R. at Quenemo	22	17S	17E	KC-CE
	Arkansas R	iver B	asin		
0.7					
07 - 1832	Neosho R. nr Chanute	4	275	18E	T-CE

Table 3.--Precipitation-record gaging stations, 1982 water year

dent. no.	Stati on name	1.0	catio	1	Coop
	Sauton name	Sec.		R.	support
	Missouri River	Basir	1	· · · · · · · · · · · · · · · · · · ·	
6 - 84 4 7	S. Fk. Sappa Cr. nr Brewster	9	95	37W	KWO
8448	S. Fk. Sappa Cr. trib. nr Goodland	36	93 8\$	37W 39W	KDOT
8449	S. Fk. Sappa Cr. nr Achilles	29	4S	30W	KWO
84568	Little Beaver Cr. nr Goodland	28	5S	39W	KWO
8460	Beaver Cr. at Ludell	30	25	32W	KWO
8476	Prairie Dog Cr. trib. at Colby	6	8\$	33W	KDOT
8479	Prairie Dog Cr. ab Keith Sebelius	23	3\$	25W	KWO
8585	Lake N. Fk. Smoky Hill R. nr McAllaster	17	125	36W	KWO
8600	Smoky Hill R. at Elkader	34	14 S	32W	KWO
8605	Hackberry Cr. nr Gove	1	135	29W	KWO
8643	Smoky Hill R. trib. at Dorrance	12	145	12W	KDOT
8647	Spring Cr. nr Kanopolis	24	15S	8W	KDOT
8668	Saline R. trib. at Collyer	32	118	25W	KWO
8689	Bullfoot trib. nr Lincoln	30	12S	7W	KDOT
87965	Kings Cr. nr Manhattan	18	115	8E	CBR
8843	Mill Cr. trib. nr Washington	5	3\$	4E	KDOT
8891	Soldier Cr. nr Goff	16	58	13E	KWO
88912	Soldier Cr. nr Bancroft	28	5\$	13E	KWO
88914	Soldier Cr. nr Soldier	4	6 S	13E	KWO
88916	Soldier Cr. nr Circleville	10	75	13E	KWO
1450700	Ladder Cr. nr Tribune	5	16S	40W	KWO

Table 3.--Precipitation-record gaging stations, 1982 water year-Continued

Ident. no.	Station name	1.0	ocatio	n	Coop or
110 •	Station maine	Sec.	Τ.	R.	support
	Arkansas River	Basir)		
)7 -					
1380	Arkansas R. nr Syracuse	18	245	40W	KWO
1386	Whitewoman Cr. trib. nr Selkirk	34	17S	39W	KWO
13865	Whitewoman Cr. nr Leoti	23	18\$	38W	KWO
1388	Lion Cr. trib. nr Modoc	22	18S	34W	KWO
1397	Arkansas R. trib. nr Dodge City	11	275	25W	KDOT
1403	Whitewoman Cr. nr Bellefont	33	245	2 1W	KDOT
1406	Pawnee R. trib. nr Kalvesta	12	235	28W	KWO
1414	S. Fk. Walnut Cr. trib. nr Dighton	16	18\$	28W	KWO
1416	Long Branch Cr. nr Ness City	32	18S	23W	KWO
1421	Rattlesnake Cr. trib. nr Mullin- ville	20	28\$	19W	KDOT
1453	Clear Cr. nr Garden Plain	33	275	3W	KDOT
1516	Rush Cr. nr Harper	21	325	7W	KDOT
1561	Sand Arroyo Cr. nr Johnson	25	298	41W	KWO
15625	Bear Cr. nr Big Bow	14	27S	39W	KWO
1571	Crooked Cr. nr Copeland	36	28\$	30W	KWO
011603	James Draw nr Lakin	10	225	36W	KWO
010347	Wally Robinson Farm nr Modoc	15	198	34W	KWO
	Cimarron R. trib. nr Hugoton	17	33S	37W	KWO
	Gray Co. landfill nr Ingalls	10	26S	29W	KWO
	Playa Lake nr Satanta	19	28\$	34W	KWO

Table 4.--Ground-water-level observation wells

County	Well numbe		Water- level notes	County	Wel numbe		Water- level notes
Allen	24S 18E 2	28CDD	Q	Douglas	12S 19E		Q
Dauch au	210 151/ 1	LADDD	۸		12S 20E		Q
Barber	31S 15W 1		A		12S 20E		R
	32S 11W 3		Q		15S 19E	HAACI	Ó
	32S 12W 0		Q	Eduanda	226 100	22000	0
	33S 11W 2		Q	Edwards	23S 19W		Q
	34S 15W 1		A		24S 17W		Q
	35S 15W 1	LICR	Α		24S 18W		0
D .	100 1511 0	200000	0		24S 19W		Q
Barton	18S 15W 2	280003	Q		25S 18W		Q
5	050 045 0		0		25S 18W		0
Bourbon	25S 24E 3	36AAC	0		26S 19W	12ABB2	Q
Cherokee	34S 25E 1	L3BAC	Q	Ellis	14S 18W		Q
					14S 18W	12ABB	Q
Cheyenne	03S 37W 1		Q				
	03S 39W 3		Q	Ellsworth	17S 09W		Q
	05S 38W 2		Q		17S 09W		Q
	05S 40W 1		Q		17S 09W		Q
	05S 42W 1	L4CBC	Q		17S N9W		Q
					17S 09W		Q
Clark	30S 23W 0)6AAA	Q		17S 09W	31AAB	0
	33S 22W 3	30CBC	0		17S 09W	31AAB2	Q
					17S 09W	31ADC	Q
Clay	06S 01E 0	D2BCD	Q				
	06S 02E 2	29DAC	Q	Finney	21S 32W	20CBD	Q
	08S 02E 0	D2CCA	Q	ŭ	21S 34W		Q
					22S 27W	14ADC	Q
Cloud	05S 02W 0	D1BAC	Q		22S 33W	22BAA	
					22S 33W		Q Q
Comanche	31S 18W 1	L9ACB	Q		22S 34W	26ADD	Q
					23S 27W	12CCC	Ò
Crawford	29S 23E 2	24DBA	Q		23S 33W		Ò
	30S 24E 1		Ò		23S 33W		Q
			,		23S 34W		Ř
					24S 31W	_	Q
Decatur	01S 29W 1	L9BDD	Q		24S 32W		Õ
- -	02S 29W 2		Q		24S 33W		Ř
	02S 29W 2		Õ		24S 33W		R
	03S 29W 1		Q		24S 33W		Q
	04S 26W 0		Õ		24S 33W		Õ

Table 4.--Ground-water-level observation wells--Continued

County	Well number	Water- level notes	County	Well number	Water- level notes
Finney (continued)	24S 33W 28DAA 25S 32W 31DD 25S 33W 03BCC	Q Q Q	Geary	11S 06E 27CBB	Q
	25S 33W 05ABD	Q	Gove	11S 26W 04CDC	Q
	25S 33W 09ABD	Q		11S 27W 16AAA	Q
	25S 33W 15DAC	Ò		11S 27W 26BCC	Ò
	25S 33W 16DCC	Q		11S 29W 04DAD	Q
	25S 33W 17DBD	Q		11S 30W 27ABB	Q
	25S 33W 35DBD	Q			
	25S 34W 06AAA	Q	Graham	6S 23W 12CCB	Α
	25S 34W 10ABB	Q		6S 24W 28BAB	Q
	25S 34W 34DBD	Q		6S 24W 35DDD	Q
	26S 33W 26ABD	Q		6S 25W 28CBC	Q
Ford	25S 22W 20AAA	Q	Grant	27S 35W 17ADD	0
	25S 22W 27CCD	Q		27S 37W 04ABB	Q
	25S 23W 11CCC	Q		27S 38W 15BBB	Q
	25S 23W 12BBB	0		27S 38W 23CB	Q
	25S 23W 14ADD	Q		27S 38W 32BCC	R
	26S 21W 17DBC	Q		28S 36W 21CDD	Q
	26S 21W 23ADA 26S 23W 10DAD	Q		28S 37W 02BBB3 28S 38W 07BBB	0
	26S 24W 29DDD	Q Q		28S 38W 17DDD	Q ()
	26S 24W 29DDD	Q		28S 38W 17AAA	Ó
	26S 24W 32CBA	Q		28\$ 38W 33BD3	Q
	26S 24W 32DDA	Q		29S 35W 06BAA	Q
	26S 24W 33CDA	Õ		29S 38W 35CCD	Õ
	26S 25W 34BBB	Q		30S 36W 01BBB	Q
	26S 26W 32DCC	Ò		30S 36W 32BBC	Ò
	27S 23W 24BCB	Q		30S 37W 03DBA	Q
	27S 24W 03BBD	Q		30S 37W 20CBC	Q
	27S 24W 03CDD	R			
	27S 24W 04BBC	Q	Gray	24S 28W 36ACA	Q
	27S 24W 09AAD	M		24S 30W 15CCC	Q
	27S 24W 16BDB	Q		26S 29W 35CCC	Q
	28S 24W 08DCC	Q		27S 27W 25CCD	Q
	28S 25W 06ABB	Q		27S 30W 23BB	0
	28S 26W 13CAA	Q		28S 30W 17BBA	Q
	29S 21W 05BBB	Q		28S 30W 24BAB	Ú
	29S 26W 29ABB	Q		29S 28W 28CDC	Q
				29S 29W 10BBB	0

Table 4.--Ground-water-level observation wells--Continued

County	Well number	Water- level notes	County	Well number	Water- level notes
Greeley	16S 39W 02BDC 16S 39W 22DCB 16S 40W 18DBA 16S 41W 20BAD 17S 39W 02BAA 17S 39W 22ABB 17S 40W 15CCB 17S 40W 31BBA 17S 42W 27CBB	Q Q Q Q Q Q Q Q Q Q	Hodgeman	23S 23W 04AAD 23S 23W 04DCA 23S 23W 12ABD 23S 24W 11DAA 23S 24W 28BCC 23S 25W 22DRB 23S 26W 07CCC 24S 23W 06AAR 24S 26W 35CBC	Q A A Q Q Q Q Q Q Q Q
Hamilton	24S 40W 17BBB 26S 42W 17CB 26S 42W 22CDB	0 Q Q	Jackson Jefferson	06S 15E 27RAB 11S 16E 25CBA	Q 0
Harvey	24S 02W 16BAA	Q		11S 17E 21ADA 11S 17E 27BBC 11S 18E 08DAC	Q O Q
Haskell	27S 33W 29DAA 27S 34W 16DDD3 28S 32W 18BBB 28S 32W 24BCC	Q Q Q Q		11S 18E 20ACC 11S 19E 27BCC 11S 19E 29CCA	Q Q Q
	28S 33W 21BCB 28S 34W 15DAR 29S 32W 26CBB2 29S 33W 28BCB 29S 34W 11ADD	Q A Q Q Q	Johnson	11S 23E 33BDD 12S 22E 21CCC 12S 22E 25BCCB 12S 22E 29BBD	() () () ()
	30S 31W 15ABB 30S 32W 11BBB 30S 32W 31BAB 30S 33W 30CBD 30S 34W 05BBB 30S 34W 30ADD2	Q Q Q Q Q	Kearny	23S 35W 12CCC 23S 37W 04ABC 24S 35W 13CCC2 25S 35W 02BAA 25S 35W 17AAA 25S 35W 26BAB 25S 36W 28BBD	Q Q Q Q Q
Hodgeman	21S 22W 12BCB 22S 22W 13CCC 22S 23W 31ADD	Q O Q		25S 37W 15ARA2 26S 36W 04BDA	Q Q O
	22S 24W 14BBC 22S 24W 15BDA 22S 24W 16ADB2 22S 24W 24DDD	() () () () ()	Kingman	27S 10W 03DDD 28S 07W 29CDD 30S 05W 12CCA	Q Q
	22S 24W 25DDC 22S 24W 26DDA 22S 24W 35DAC 23S 22W 07DAA	0 A Q Q	Ki owa	27S 17W 21ADC 27S 18W 13AAA 27S 18W 18DDC	Q Q Q

Table 4.--Ground-water-level observation wells--Continued

County		We numl		Water- level notes	County	1	Wel numb		Water- level notes
Kiowa (continued)	285	19W	26ABD 10AAC 02ACC	Q Q O	Osborne	075	12W	23CDC 28ABA 10CCC	0 0 0
Labette	315	21E	15CCC2	Q	Pawnee			32DAA 30BCC	Q Q
Lane	17S	28W	26ABB	Q				29BBB	Õ
Lunc			13CBB	Q				O3AAA	Ϋ́
			13CCC	Õ				03AAA2	Õ
			02AAA	Q				06BBA	Q
	100	0011	OLIVIA	٧				23AAA	ñ
Leavenworth	125	22F	21BCD	Q				18AAD	Q Q Q
Leavenworth			22CAA	Q				07AAA	ñ
	123	<i></i>	ZZOAA	Ų				10BBA	Q
Logan	115	32W	04ACD	Q				28DAD	ď
Logan			19AAB	Õ		200		LOBINIT	4
			06ADD2	Q	Phillips	045	18W	23CDC	Q
McPherson	17S	03W	04BBB	0	Pottawatomie			19CDB	Q
			34AAA	Q		098	11E	27CAA	Q
	17S	05W	07CBB	Q				31DCC	Q Q
	17S	05W	25AAA	Q				32ADC	Q
								34CAB	R
Meade			22CDD	Q				35DDD	Q
	30S	27W	32DDD	Q			08E	12CBB	Q
	30S	30W	28ABB	Q			08E	14CBA	Q
	32S	28W	04ADD	Q			10E	10DBC	Q
	33S	28W	29BCB	Q				O1CBC	R
	33\$	30W	35CB	Q				03BCA	Q
								04ACB	Q
Morton	31\$	39W	33BCC	Q		10S	12E	07BBC	Q
	31S	40W	29ABB	Q					
			14DDC	Q	Pratt			34CDC	Q
	32S	42W	21BCC	Q				34CDC2	Q
	33\$	40W	27CCC	Q				34BCB	Q
	33\$	41W	03AAD	Q				17DCB	Q
	35\$	40W	03BBB	Q				12DAA	Q
						275	14W	12DDD	Q
Ness	18S	21W	31CAA	Q					
	19S	23W	O1CCB	Q	Rawlins			03DCC	Q
	19 S	23W	08CBB	Q				17CCC	Q
	20S	22W	20CCC	Q				06BBB	Q
	200	2211	32CDA	Q		UEC	2 214	29BDA	Q

Table 4.--Ground-water-level observation wells--Continued

County	Well number	Water- level notes	County	Well number	Water- level notes
Reno	22S 06W 33BAB 23S 06W 31DCB 23S 09W 35CCC	Q Q Q	Scott	16S 33W 19CBB 17S 32W 27BBB 17S 34W 06BCB	Q Q Q
	26S 10W 18CDC	Q		18S 32W 17ABA 18S 33W 05CCC	Q Q
Republic	01S 03W 01CCA	Q		18S 33W 26DAD2	Q
	01S 03W 09C 01S 04W 15AAA	Q Q		18S 34W 25BBD 19S 32W 06CCB	Q Q
	013 04W 13AAA	Ų		19S 32W 000CB	Q
Rice	18S 09W 04BCC	Q		19S 33W 15DBD	Q
	18S 02W 04BCC2 18S 10W 24BBB	Q Q		19S 33W 29CBB2 20S 32W 07CBA	Q Q
	20S 08W 22AAA	Q		20S 33W 09BBB	R
	20S 09W 12DDA 21S 08W 09CBD	Q Q	•	20S 33W 21ABD	Q
	21S 08W 25ABB	Ò	Sedgwick	25S 01W 26DRD	Q
Dilou	100 075 240442	0		26S 01W 19ABA 26S 01W 31CCC	Q
Riley	10S 07E 34BAA2 10S 07E 35DBB	Q Q		26S 01W 31CCC2	Q O
	10S 08E 23CDC	Q		26S 02W 02DDD	Q Q Q
	10S 09E 17BDD	Q		26S 02W 02DDD2	Ò
	10S 09E 19BBA	Q		26S 02W 07AAA	Q
	11S 07E 01BCC	Q		26S 02W 07AAA2 26S 02W 10BBB	Q Q Q
				26S 02W 10DAA	Õ
Rooks	07S 17W 24BBB	Q		26S 02W 14BAA	Q Q
	07S 19W 23CDB	Q		26S 02W 14DDD	Q
Rush	18S 17W 14BCC	Α		26S 02W 15CBC 26S 02W 15DBB	Q Q
itus.ii	18S 17W 14CCC	Q		26S 02W 22ABA	Q
	18S 17W 14CDC	Α		26S 02W 23CCC	Q
	18S 17W 15DAA	Q		26S 02W 24DDD	Q
	18S 17W 22AAD	Q		26S 02W 29AAA	Q
	18S 17W 23BCC 18S 18W 22DDD	Q		28S 01W 11BCB	0
	18S 18W 27AAC	A Q		28S 01S 11CCD 28S 01W 15ACA	Q Q
	18S 18W 27CCB	Ä		203 01W 13AQA	Ÿ
	18S 19W 20ADD	Q	Seward	31S 31W 08BCC	Q
	18S 20W 14CCC	Ó		32S 32W 14BBB	Ó
	18S 20W 19AAD	Q		32S 33W 21CDB	Q
Calina	160 00U 10000	0		34S 33W 07CCB	0
Saline	16S 02W 18BBB 16S 03W 23DDD	Q		35S 34W 10BBB	Q

Table 4.--Ground-water-level observation wells--Continued

County	Well number	Water- level notes	County	Well number	Water- level notes
Shawnee	11S 12E 01ABA 11S 13E 04ADA 11S 14E 13BBB 11S 14E 15ABB 11S 14E 18CBB 11S 14E 22CCC 11S 14E 24BBB 11S 15E 13DBC 11S 15E 14ADB 11S 15E 16DCA 11S 15E 23DBD2 11S 15E 24DBD	Q O Q O Q O Q R Q O	Stanton	27S 39W 27BBA 27S 40W 21DAA 27S 42W 31CCC 28S 39W 14BBC 28S 39W 36ABB 28S 40W 12DDD2 29S 41W 13ACC 29S 42W 24CCC 30S 40W 24CDC 30S 43W 34BBB 31S 35W 19CCC	000000000000000000000000000000000000000
	11S 16E 19DDD 11S 16E 29ACA	0 Q		31S 36W 02CDD 31S 37W 22BCC 32S 35W 08DDD	Q Q Q
Sheridan	06S 30W 13BAA 07S 26W 19BBC 07S 28W 08BDC 07S 29W 27CCC	0 Q Q Q		33S 38W 20DDB 34S 35W 18BCA 34S 38W 02CAC	Q Q Q
	08S 30W 13DAA 09S 30W 35BBB 10S 30W 08DDD	0 0 0 Q	Thomas	06S 32W 34CBC 06S 34W 01DDD 06S 34W 17CBC 06S 35W 26ACB	0 0 Q Q
Sherman	06S 42W 02AAA 07S 37W 04BBC 07S 40W 36BAB 07S 41W 10BBA 08S 39W 15CCC 08S 40W 12DBA 08S 40W 20CCC 08S 40W 25AAC 08S 42W 31DCD 09S 39W 19CCC 09S 40W 29BBB	000000000000000000000000000000000000000	Trego	07S 36W 17CCC 08S 31W 03CDD 08S 32W 27DAB 08S 33W 34BBC 08S 34W 01BAC 08S 36W 18ABA2 09S 32W 27BCD 09S 33W 26DAD 10S 33W 06BBC	Q Q Q R Q Q Q Q
	09S 42W 08AAA 09S 42W 14AAA	Q Q	Wahaunsee	10S 10E 15DCC 10S 12E 29ADD	0 0
Stafford	21S 13W 27DDD2 22S 13W 29DAD 23S 13W 08CCB 23S 14W 30BBB 24S 13W 30BCB 24S 13W 36DDD 25S 11W 23DDD 25S 13W 03BBB 25S 13W 16ACC	Q Q Q Q Q Q	Wallace	11S 38W 35CCC2 11S 42W 08DDC 13S 39W 33BBB 13S 42W 10BAC 14S 42W 14DBD 15S 38W 28DBB 15S 39W 02BCD 15S 39W 08ACC	0 0 0 0 0 0

Table 4.--Ground-water-level observation wells--Continued

County	Well number	Water- level notes	County	Well number	Water- level notes
Wallace (continued)	15S 39W 26ACC 15S 40W 03BAB 15S 40W 26CAB 15S 41W 10BAB 15S 41W 36DDB2	Q Q Q Q			
Washington	01S 05E 05ADA 04S 02E 14CCC 05S 01E 20ADA 05S 01E 31DDD	Q Q Q Q			
Wichita	16S 35W 20CCC 16S 37W 13BBC 16S 37W 30ACB 16S 38W 10ABB 17S 35W 30CBB 17S 36W 33BCB 17S 37W 28CCC 17S 38W 21BBB 18S 35W 14DCD 18S 37W 21BBB 18S 38W 20ACC2	Q Q Q Q Q Q Q Q			
Wyandotte	11S 24E 14DBA 11S 24E 31DAB 11S 24E 32ABA2 11S 25E 20BAB2	0 Q Q Q			

Table 5.--Surface-water-quality stations, 1982 water year

Ident. no.	Station name	Sampling purpose	Coop. or support
	Missouri Riv	er Basin	
06-			
8447	S. Fk. Sappa Cr. nr Brewster	SED	KWO
8465	Beaver Cr. at Cedar Bluffs	SED, BED	KWO
8479	Prairie Dog Cr. ab Keith Sebelius Lake	SED	KWO
84795	Keith Sebelius Lake nr Norton	CHEM, COLI, FIELD	MRB
8538	White Rock Cr. nr Burr Oak	SED	KWO
8566	Republican R. at Clay Center	CHEM, BIOL, TOC, METAL, COLI, FIELD, SED	NASQAN
8585	N. Fk. Smoky Hill R. nr McAllaster	SED	KWO
8615	Cedar Bluff Res. nr Ellis	CHEM, COLI, FIELD	MRB
8635	Big Cr. nr Hays	SED	KWO
8639	N. Fk. Big Cr. nr Victoria	SED	KMU
8670	Saline R. nr Russell	SED	KWO
8695	Saline R. at Tescott	SED, BED	KWO
8702	Smoky Hill R. at New Cambria	OBS	KWO
8710	N. Fk. Solomon R. at Glade	SED	KWO
8725	N. Fk. Solomon R. at Portis	CHEM, FIELD	MRB
8730	S. Fk. Solomon R. ab Webster Res.	SED	KW0
87346	S. Fk. Solomon R. at Woodston	CHEM, FIELD	USBR
8740	S. Fk. Solomon R. at Osborne	CHEM, FIELD	MRB
8759	Solomon R. nr Glen Elder	CHEM, COLI, FIELD	MRB
87644	Solomon R. nr Minneapolis	CHEM, COLI, FIELD	USBR
8769 8776	Solomon R. at Niles Smoky Hill R. at Enterprise	SED, BED, OBS CHEM, BIOL, TOC, METAL, SED, BED, COLI, FIELD OBS, PEST	KDHE NASQAN/KWO
87965	Kings Cr. nr Manhattan	CHEM, METAL, TOC, RAD, FIELD, SED	BENCHMARK CBR
8844	Little Blue R. nr Barnes	SED SED	KWO
8870	Big Blue R. nr Manhattan	CHEM, BIOL, TOC, METAL, SED, COLI, FIELD	NASQAN
8875	Kansas R. at Wamego	SED, BED	KWO
8920	Stranger Cr. nr Tonganoxie	SED	KWO
89235	Kansas R. at DeSoto	CHEM, BIOL, TOC, METAL, SED, BED, COLI, FIELD, PEST	NASQAN

Table 5.--Surface-water-quality stations, 1982 water year--Continued

Ident. no.	Station name	Sampling purpose	Coop. or support
06-			
9119	Dragoon Cr. nr Burlingame	SED	KWO
9140	Pottawatomie Cr. nr Garnett	SED	KWO
9166	Marais des Cygnes R. nr Ks Mo. State line	SED	KC-CE
9170	Little Osage R. at Fulton	SED	KC-CE
943809	N. Sugar Cr. trib. 1	CHEM, METAL, SED, FIELD	OFA
943824	N. Sugar Cr. trib. 2	CHEM, METAL, SED, FIELD	OFA
944038	N. Sugar Cr. trib. 3	CHEM, METAL, SED, FIELD	OFA
	Arkansas Rive	er Basin	
)7-			
1375	Arkansas R. nr Coolidge	CHEM, BIOL, TOC, METAL, PEST, COLI, FIELD, SED	NASQAN
1380	Arkansas R. at Syracuse	SED, BED,	KWO
13865	Whitewoman Cr. nr Leoti	SED, BED	KWO
1398	Mulberry Cr. nr Dodge City	SED	KWO
1400	Arkansas R. nr Kinsley	SED, BED	KWo
1412	Pawnee R. nr Larned	SED	KWO
1419	Walnut Cr. at Albert	SED, BED	KWO
1423	Rattlesnake Cr. nr Macksville	SED	KW0
14286	Cow Cr. nr Claflin	SED	KWO
1433	Cow Cr. nr Lyons	SED	KWO
14333	Arkansas R. nr Hutchinson	SED, BED	KWO
143665	Little Ark. R. at Alta Mills	SED	KWO
1442	Little Ark. R. at Valley Ctr.	SED	T-CE
14478	N. Fk. Ninnescah R. ab Cheney Res.	SED, BED	KWO
14491	S. Fk. Ninnescah R. nr Pratt	SED	KWO
1452	S. Fk. Ninnescah R. nr Murdock	SED, BED	KWO
1455	Ninnescah R. nr Peck	SED, BED	KWO
1457	Slate Creek at Wellington	SED SED	KWO
1465	Arkansas R. at Arkansas City	CHEM, BIOL, TOC, METAL, RAD, PEST, SED, BED, COLI, FIELD	KWO/ NASQAN T-CE
14707	Whitewater R. at Towanda	SED SED	KMU
1478	Walnut R. at Winfield	SED	KWO
15601	N. Fk. Cimarron R. at Rich- field	SED	KW0
15622	Bear Cr. nr Johnson	SED, BED	KWO
		-	

Table 5.--Surface-water-quality stations, 1982 water year--Continued

Ident.	Station name	Sampling purpose	Coop. or support
07-			
1575	Crooked Cr. nr Nye	SED	KWO
1579	Cavalry Cr. at Coldwater	SED, BED	KWO
1675	Otter Cr. at Climax	SED	T-CE
1698	Elk R. at Elk Falls	SED	T-CE
1707	Big Hill Cr. nr Cherryvale	SED	T-CE
1795	Neosho R. at Council Grove	SED	T-CE
17973	Neosho R. nr Americus	SED	T-CE
179795	Cottonwood R. nr Plymouth	SED	T-CE
18225	Cottonwood R. nr Plymouth	SED	T-CE
1835	Neosho R. nr Parsons	CHEM, BIOL, TOC, METAL,	NASQAN/
		SED, COLI, FIELD	KWO
1840	Lightning Cr. nr McCune	SED	KWO
1843	Cherry Cr. nr Hallowell	CHEM	KDHE
18604	Cow Cr. nr Weir	CHEM	KDHE